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Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

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The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

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Eleventh Annual Meeting, Pacific Coast Gas Association.

PACIFIC COAST GAS ASSOCIATION,
OFFICE OF THE SECRETARY,
SAN FRANCISCO, CAL., June 16, 1903.

The Eleventh Annual Meeting of the Pacific Coast Gas Association will be held in San Francisco, Cal., at the offices of the Pacific Gas Improvement Company, 455 Sutter street, Tuesday, Wednesday and Thursday, July 21st, 22d and 23d, 1903. The following papers will be read:

President's Address; by Mr. M. C. Osborn, San Francisco, Cal.

Wrought Pipe; by Mr. Franklin Riffle, San Francisco, Cal.

High Pressure Gas Distribution; by Mr. John A. Britton, Oakland, Cal.

Liquid Air: Its Application to the Gas Industry; by Prof. G. A. Bobrick, Los Angeles, Cal.

The Oil Industry of California from a Commercial Standpoint; by Dr. C. T. Deane, San Francisco, Cal.

Our Customers and Their Complaints; by Mr. D. Decker, Santa Rosa, Cal.

A Paper (subject to be announced later); by Mr. L. P. Lowe, San Francisco, Cal.

In addition to the above papers there will probably be contributions by at least two of the members on "Short Topics" of interest to the fraternity.

Arrangements have been made for a popular lecture on Liquid Air, by Prof. Bobrick, which will be given at the regular meeting place, Tuesday evening, July 21st, 1903. The lecture will be accompanied by experiments. It is the intention to make this lecture essentially a popular one, and members are cordially invited to bring their friends including ladies. Informality will be the order of the evening.

Wednesday evening, July 22d, will be the occasion of the annual banquet, to be held at Delmonico's, at which members only will be present.

On Thursday, July 23d, an all-day trolley car ride will be given and members will be conveyed by special cars to many points of scenic and historic interest in San Francisco and thereabout. An opportunity will also be afforded them to inspect at least one of the large power plants in the great Metropolis of the Pacific. Luncheon will be served at the Cliff House, and ample time will be allowed for a visit to Sutro baths (the largest in the world), or a stroll upon the beach. Following the usual custom, ladies will be welcome on the outing.

Through the courtesy of the Mechanics' Institute, arrangements have been made whereby the privileges of the Mechanics' Library, 33 Post street, are granted to all members of the Pacific Coast Gas Association during the period of its 11th annual meeting. Mr. J. M. Cummings, Secretary, acting for the Institute, extends to members a cordial invitation to make free use of the books and rooms of the Library, and will take pleasure in giving them any information or assisting them in any way in the use of the Library. It is hoped that members will show their appreciation by availing themselves of these privileges. No entrance tickets are required, but members will kindly wear the convention badge as a means of identification.

Members are strongly urged to lend their individual support to

JUL 20 1903
SMITHSONIAN DEPOSIT

The Wrinkle Department: Mr. Geo. H. Colquhoun, Fresno, Cal., Editor.

The Experience Department: Mr. R. P. Valentine, Sacramento, Cal., Editor.

The Novelty Department: Mr. Geo. H. Hollidge, Merced, Cal., Committee in charge.

The Wrinkle and Experience Departments depend for their very existence upon the willingness of members to contribute, and are an index of the "lag" or "lead" of the Association as a whole. Please remember this and help to maintain the standard.

The Novelty Department is, in truth, a novelty this year. In it we hope to find samples or models of all the good things manufactured during the past year for which a "gas man" has use. If you know of any, communicate immediately with Mr. Hollidge.

The Question Box.—An effort is being made this year to give the Question Box the attention which it merits, and to this end a special communication has been issued on the subject. An immediate reply thereto is requested.

The Secretary will be glad to meet members and furnish information, at any time prior to the meeting, at 628 Rialto Building, San Francisco, Cal.

J. B. GRIMWOOD, Secretary.

BRIEFLY TOLD.

DEATH OF MR. EUGENE VANDERPOOL.—With profound sorrow we announce the death of Mr. Eugene Vanderpool, whose demise occurred at his home in Newark, N. J., Sunday, July 12th. His death, which was as unexpected as it was distressing, resulted from shock consequent upon an operation for appendicitis, the operation having been performed earlier in the day. The preliminary symptoms of the disease had been manifest only 2 or 3 days prior to the operation, but so great had been its inroads that the surgeon's instruments unfortunately only revealed the fact that there was no hope. Born in Newark, N. J., in 1844, he was on the paternal side from a family famous in the religious, civic, financial and social history of the State of New Jersey, and when he came to manhood's estate right worthily and well did he continue to pace in the paths that had been marked out by his ancestors. To the fraternity we need say nothing of his ability, straightforwardness and sturdy honor; these are as an open book to them. But the stroke of God has fallen, and to its sting we may offer no resentment. The funeral service was held at his late residence, 22 Washington Place, Newark, the afternoon of the 15th inst., the celebrant being the Right Reverend Dr. John Scarborough, Bishop of the Episcopal Diocese of New Jersey, and the mourning assemblage numbered the leading people of the State, in almost every division of its pulsing business and social life. The Society of Gas Lighting was personated by a representative and numerous delegation. Of this sterling body he was President, and since its inception had been an active and zealous member. The honorary pallbearers were: Franklin Murphy, Governor of New Jersey; Chief Justice William S. Gummere, Vice-Chancellor Jno R. Emery, Dr. Charles J. Kipp, Frederick Frelinghuysen, Robert F. Ballantyne, F. W. Jackson, James R. Sayre, Amzi Dodd and Oscar Kean. Interment was made in the family vault at Mount Pleasant Cemetery. We have in preparation a history of his brilliant, successful, valuable and good life.

NOTES—

AS was intimated heretofore in the JOURNAL would be the case, the Directors of the Louisville (Ky.) Gas Company have ordered the dividend rate increased from 5 to 6 per cent. per annum. The Directors in organizing the Board named the following officers: President, Mr. Udolpho Snead; Vice-President, Mr. John Stites; Executive Committee, Messrs. George Gaulbert, K. W. Smith and Hector V. Loving.

MR. B. C. COBB, who has served the Saginaw City (Mich.) Gas Company for some time as Manager, has been appointed Managing Director of the combination which has secured title to the gas, electric lighting and street railway interests of Saginaw and Bay City. The President of the succeeding concern is Mr. John V. Hewett, of Bay City, and its Treasurer is Mr. R. S. Storrs, of New York.

AT a meeting of the United Gas and Electric Company, New Albany and Jeffersonville, Ind., the officers chosen were: President, Mr. Samuel Insull, of Chicago; Vice-President and Treasurer, Mr. R. W. Waite; Secretary, Mr. J. O. English; General Superintendent, Mr. James W. Dunbar.

MR. SAMUEL BALL has been selected for the gas scholarship at the University of Michigan, which scholarship is maintained by the Michigan Gas Association. The subject over which he is to devote most of his study during the period of his scholarship is that of "Naphthaline."

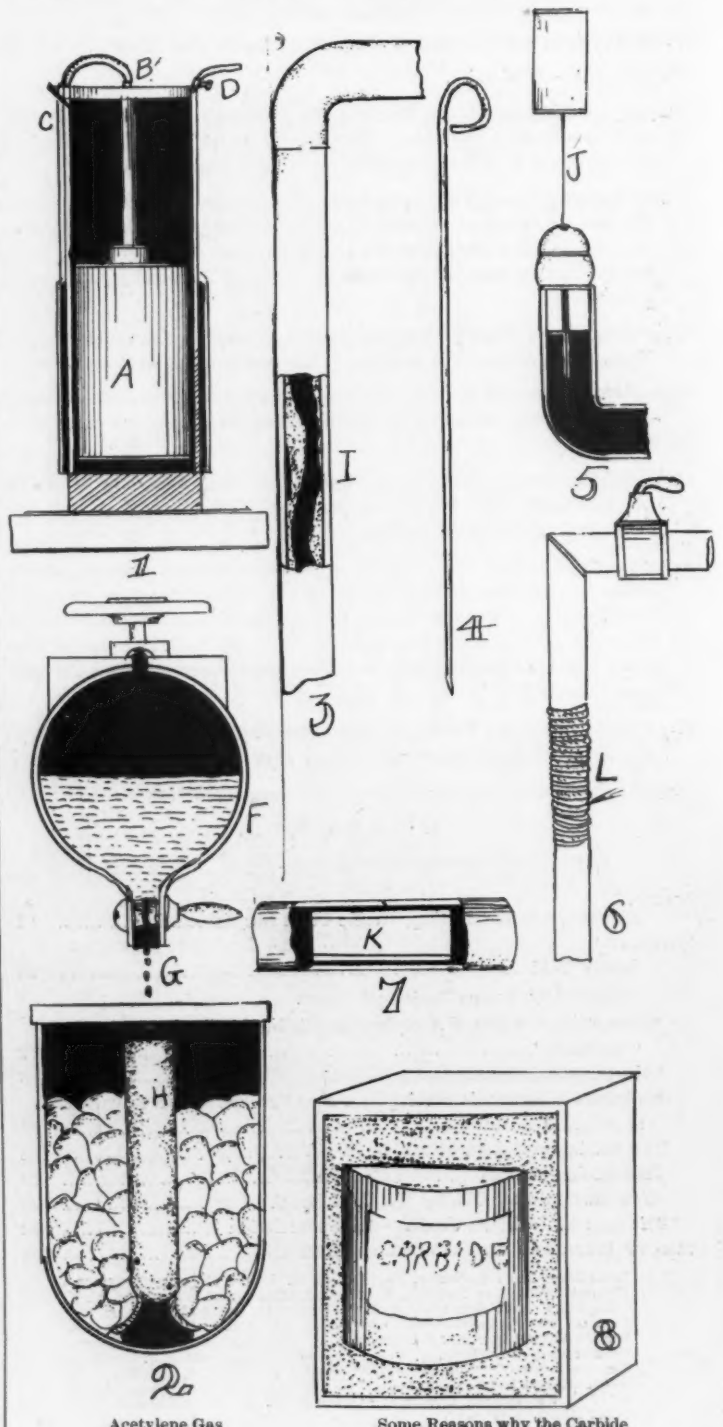
MR. C. I. TENNEY has resigned the position of President of the Practical Gas Company, the headquarters of which concern are in Chicago.

[Prepared for the JOURNAL]

Concerning the Use of Acetylene Lights in Foreign Countries.

By "AN EXILE."

Apparatus and Systems Used.—In America, England, Germany and other advanced countries where users of lights have access to all kinds of modern gas lighting, electrical illumination, etc, acetylene does not cut so very much of a figure; but in a great many portions of the world, recently travelled by the writer, acetylene gas lamps are used quite freely in the lighting of homes, street lighting, public buildings, workshops, etc. The extensive usage of this form of light is of recent origin in all the countries visited in the far East, the islands of the Pacific and the like. I visited Japan and found there quite elaborate plants for making gas from carbide and burning the same. In the Philippines they use the acetylene lights for cooking purposes, lighting, picture projection and advertising purposes. Borneo is likewise fitted out with all manner of improved forms of acetylene gas contrivances. In Honolulu your correspondent saw fine plants fitted up for utilizing this bright, white light; likewise on the Sulu Archipelago. There are practically no gas or suitable electrical light producing plants in many of these places and the carbide gas making devices are used to advantage.



Acetylene Gas Burning Devices.

Some Reasons why the Carbide Gases Fail to Give Satisfaction.

Carbide Difficult to get in Some Places.—One of the difficulties experienced by users of acetylene lights and cooking devices in these countries, except where they manufacture the stock, is the procuring of same. The passenger steamers refuse to accept the carbide from American and other ports, and sailing vessels are depended upon. The carbide sells at an advance of about 40 per cent. over United States prices in these countries of the Pacific. The high temperature required to manufacture calcium carbide has prevented its production almost everywhere.

The Gas.—The gas, as is known, is a colorless product, possessing an odor due to impurities in the coke and lime. When properly burned, however, in lighting devices or stoves, there is no odor. The illuminating power is greater than that from other gases. It is in a measure a cheap illuminant, and for that reason appeals to the users of lights in these islands of the Pacific.

Apparatus.—I found varied types of devices in use in Nagasaki, Japan, Sumatra, and other places, and observed that some of the apparatus was from the United States. In some cases the native smiths have made apparatus in their own shops, using the imported device for a model. One type of generator used is shown in Fig. 1, consisting of an exterior cylinder or tank of sheet metal, about 8 inches diameter and 20 inches high, with interior portion *A*, inside of which the basket of carbide is placed. Water is admitted through the top and the gas generated passes up through pipe *B*, and down and about the cylinder of water for cooling by means of side pipes *C*. Thence the gas passes out at *D*, to the gas consuming jets.

Water Dropped to the Carbide.—I observed that a goodly percentage of the gas burning devices were planned with a view of having the carbide either dropped into water instead of using water-feed generators, or that water was arranged to drop upon the carbide as needed to make the gas. Fig. 2 shows one of the water-feed devices. The water is contained in the globe *F*, and passes out at *G* in form of drops. These drops of water enter the center tube *H*, of the carbide vessel and emerge through perforations at the base of the tube. As soon as the water comes into contact with the carbide, the gases generate and are received into proper pipe connections and carried to the jets.

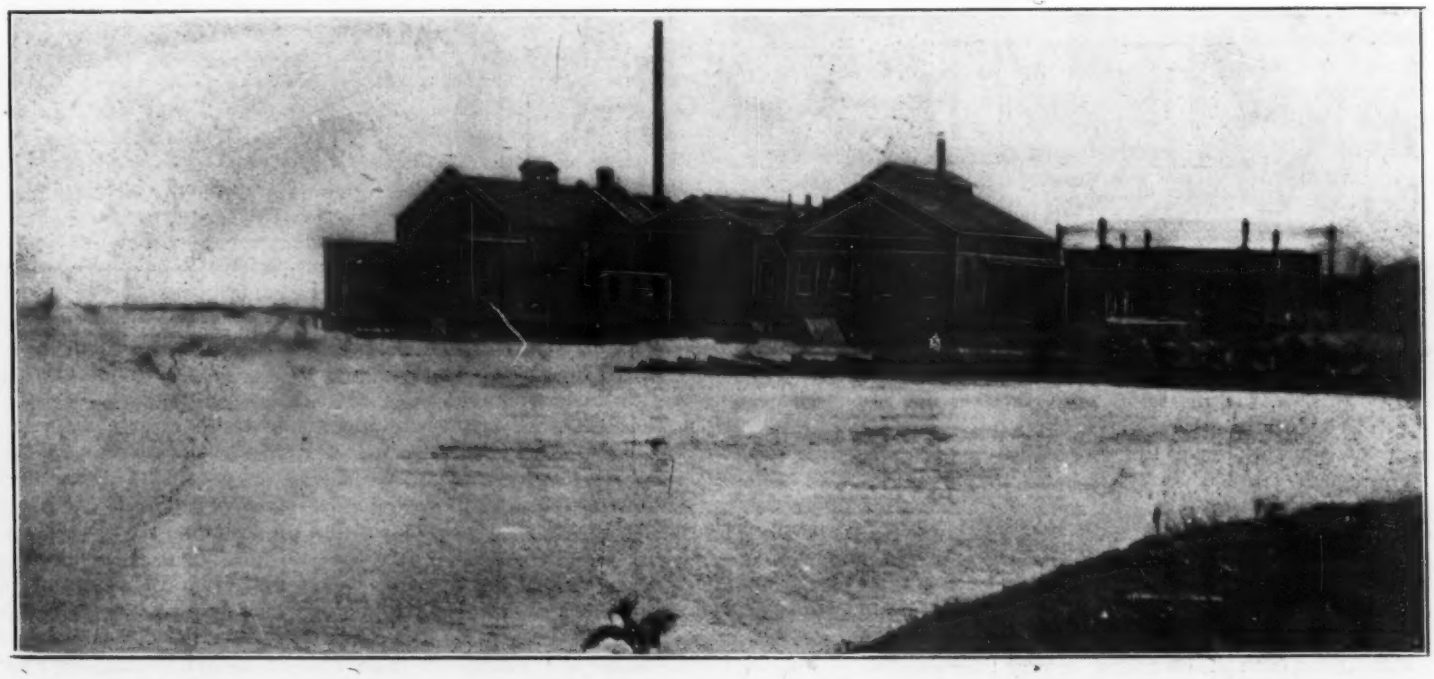
Troubles.—I am convinced that there is a most excellent field in all of the foreign countries in this part of the world for manufacturers of carbide gas apparatus to sell their goods. I am aware that very many of those persons who brought carbide burning and cooking apparatus with them to the Philippines, Borneo, and similar places, have been offered very high prices for the devices. Still the people of this section of the world have their troubles with the carbide light devices. The Sultan of Jolo, for example, permitted your correspondent to examine an acetylene gas outfit which he had purchased from England for lighting up some tobacco works he was running at night. I went out to his plantation to examine the device and found that one of the main pipes for carrying the gas to the jets was clogged up with the rich residue of carbide, until only a narrow passage was left, as at *I*, Fig. 3. I secured some wire and drew it up and down through the pipe, wiping off the residue each time, until the passage was opened, after which the gas was able to reach the burners full force and burn brightly, to the joy of the Sultan; talk about experts! Again I found that one party, running a picture projection stereopticon at Iloilo, on the island of Panay, of the Philippines, had transported his cylinder on a pack mule to a certain point; the troubles of transit caused a leak, so that most of the gas escaped. He did not notice the leak and supposed the carbide was bad, as only a small jet was made. After the leak was soldered the flame burned brightly. Manufacturers of carbide gas burning devices will do well to send plainly printed instructions with all acetylene generators sent to these courtries. Wire is not always procurable, of proper size, for pipe cleaning, and it would be wise to include with the device a straight bit of wire like that shown in Fig. 4. Fine wire devices for cleaning out the pinholes of the little lava jets ought also be sent. Fig. 5 shows sectional view of a fine wire tool in use for this purpose. I found several acetylene outfits discredited simply because of clogged burners.

Patchwork Prominent.—The natives of these countries are pretty sure to do more or less patching of almost every portion of the apparatus. I found great jumbles of cordage wrapped about pipes in which only little pinhole leaks existed, and which holes could be stopped with a little soldering; but the native winds a place of the order pretty much as shown at *L*, Fig. 6, and the worst of it is that this does not always stop the leak. Broken pipes he fixes by inserting a thimble, or a piece of smaller pipe inside, as at *K*, in the sectional drawing of a united pipe shown in Fig. 7.

Transportation.—Shipment of carbide in 1 to 10-pound cans from one place to another in these tropical countries is no small item of work and expense. I was in localities where carbide sold at 50 cents gold per pound, and the dealers had all they could do to fill orders. It is customary to pack the can of carbide in sawdust, straw or paper, in a box, as represented in Fig. 8. The cover is nailed on and the can is ready for transportation. I believe that there is quite a future for acetelyne gas burning lights and cooking stoves in this section of the world. I observed that projection lanterns were used considerably for displaying advertising signs on sheets strung up on thoroughfares, in places like Honolulu, Nagasaki, Manila, Iloilo, Zamboanago and Borneo.

Almost Afloat.

The illustration shows how the works of the East St. Louis (Ills.) Company were situated during the trying times of the floods occasioned by the Mississippi river failing to properly assimilate the torrents that were poured into it early last June in the neighborhood of St. Louis, Mo. The illustration is reproduced from a photograph taken by Miss Lilian Maguire, daughter of Mr. Henry Maguire, General Manager of the East St. Louis plant.



Sulphate of Ammonia Making by a New Process.

[A paper read by MR. J. BALLANTYNE at the Annual General Meeting of the English Institution of Gas Engineers, held in London, June 9th, 10th and 11th.]

Many methods have been tried for making sulphate of ammonia in the past, and one known as the "intermittent"—still found in some small works—long held a foremost place. In course of time it was supplanted by a modification of the Coffey still, which became known as the "continuous" process; and it has been largely introduced during recent years into works where sulphate was not previously made. Now another competitor has appeared in the field, which may be termed the "continuous vacuum" process; and it will probably in the course of a few years largely supplant the present continuous method, as the system of working under vacuum has been introduced of late with great success into various commercial manufacturing concerns.

The first vacuum plant for making sulphate of ammonia was erected at Hamilton in 1901 by Messrs. Ernest Scott & Company, of London and Glasgow. Naturally, the plant was of an experimental nature, being the first of the kind, and took some time to develop, as there were a number of details in connection with the working of it which required attention. But after a time these difficulties were all successfully overcome, and the result is that a plant has now been devised which is eminently satisfactory in every way, and which I think will soon take a foremost place in the manufacture of sulphate of ammonia.

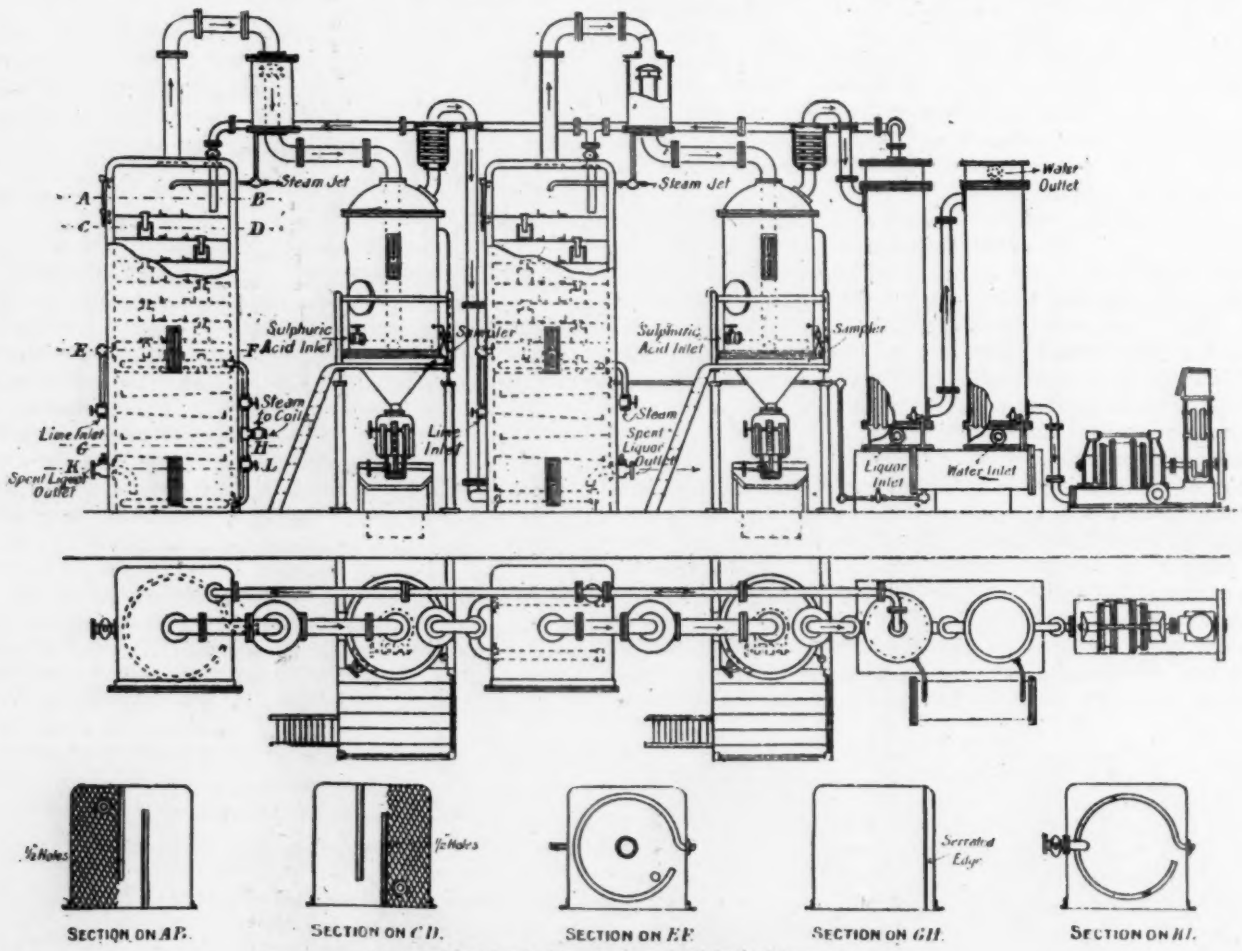
The general arrangement is something similar to that of an ordinary continuous plant working under pressure; but there is in addition an engine and vacuum pump provided for keeping the plant under a high vacuum while it is in operation. The vacuum on the pump may be as high as 28 or 29 inches of mercury—that is, equal to lifting a column of water about 31 or 32 feet. This has enabled us to do away with all overhead tanks for liquor and acid, as these can be drawn into the still and saturated from the floor level, or very little above it.

The ammoniacal liquor on its way to the still is first heated in a superheater or economizer by the waste gases of the plant. It then passes into the still at the top, and travels backwards and forwards over the trays, which are formed of steel plates, and provided with baffles on one-half of the tray, the other half being perforated with ¼-inch holes through which the steam and gases rise. The liquor overflows to the next tray by an overflow pipe dipping into a suitable seal pot. The pipe is so arranged that the liquor on the tray is about ½ inch deep, and the steam and gases as they ascend through the holes prevent the liquor passing down them, and at the same time bubble through it in a large number of small streams, thus effectually driving off all the free ammonia.

By this arrangement of making the steam and gases pass through the holes, all the liquor is brought into close contact with them before passing to the next tray. The overflow is placed at the end of the travel, and the liquor must pass over the holes to reach it. There are no hoods, cups, or other appliances used. This process is continued over the trays until the middle of the still is reached, when the liquor passes into the liming chamber, and is mixed with milk of lime in the usual way. In this chamber, a perforated steam coil is placed, which thoroughly agitates the liquor, causing evolution of the various gases.

After leaving the liming chamber, the liquor flows over another series of trays, which, instead of being perforated, have serrated edges over which the liquor passes in its passage from one tray to the other; the gases and steam rising between the serrations and the sides of the still. In the bottom of the still is another perforated steam coil which keeps the liquor agitated, and produces sufficient heat for driving off the last traces of ammonia.

The gases after leaving the still go through a large baffle vessel or trap on the way to the saturator. The only live steam required for the still is in connection with this trap. It is not possible to get an effective seal on the pipe from the trap for returning the liquor to the still should it froth up and overflow. The priming over of the still into the saturator is of frequent occurrence with most plants. To entirely prevent it in the vacuum plant, a small steam jet is introduced, which acts like an injector, and blows any liquor which may get into the trap back into the top of the still. The return pipe from the trap is carried into the center of the still, and has a knee on its end looking downwards; and the steam and any liquor which may get into the trap, as they rush out at the knee into the top space of the still, have the effect of breaking up the froth, and driving it back—thus reducing to a minimum any liquor getting over into the trap. Since a similar arrangement was fixed on our still, we have never had the slighest trace of priming.



Vacuum Plant for the Manufacture of Sulphate of Ammonia.

Our plant originally had no provision for priming, and it was surprising how seldom it occurred. The steam jet is so arranged that it is easily withdrawn and examined, and the orifice cleaned if necessary, while the plant is working. I would also here point out that many little repairs can be effected on a vacuum plant while working, which could not be done with a plant under pressure.

The gases are brought down the center of the saturator by a lead pipe, from which radiate three or four distributers fixed to copper supports, with copper straps and bolts, so that they cannot wobble about in any way, but remain quite rigid in their positions. The saturator at Hamilton has now made about 300 tons of sulphate, and when examined recently the holes in the distributers were as perfect as when they were first made; there being not the slightest trace of wearing or fracture of any kind to be seen on the holes. This is remarkable, especially when it is compared with the condition of distributers of ordinary plant, which are generally found to have the holes enormously enlarged and torn, thus impairing their distributing powers. The perfection of the holes in the vacuum distributers is undoubtedly due to the plant being under vacuum, which allows the gases to freely escape without pressure of any kind.

The saturator is a cylindrical vessel made of copper with a semicircular top and conical bottom; the distributers being placed immediately above the conical part. To the bottom of the saturator is fixed a discharger, which opens into the saturator by an internal valve operated by a handwheel and pinions from without. When the discharger is full the internal valve is shut and that on the side opened, and the sulphate is raked out on to the draining table; the quantity withdrawn being about 1 cwt. at a time. This operation only occupies a minute or two, when the valves are reversed, and the operator is at liberty to attend to other matters, and wheel the sulphate into the store. For larger plant, the discharger can be made to discharge from the bottom into a suitable movable vessel running on rails from which it can be tipped into the store. The sulphate when withdrawn from the discharger is nearly dry, and is very soon ready for filling into bags. We find the best salting point of the saturator to be from 56° to 57° Twaddel. A simple arrangement allows a sample of the liquor in the saturator to be withdrawn at any time for testing. The saturator requires no wood lagging or covering of any kind.

The waste gases after leaving the saturator pass through a baffle box, and then into the superheater for heating the liquor before the latter enters the still. From the superheater the gases go through a water tubular condenser to be cooled before passing through the vacuum pump on their way to the purifiers. Burning the waste gases is not now sanctioned under the Alkali Act, unless in the production of sulphuric acid or some other way whereby the sulphur may be recovered. The vacuum pump at Hamilton is a water displacement one, and requires that the gases should be cooled before entering it; but I understand the firm now supply a dry vacuum pump, and the gases do not require to be cooled to the same extent before going through it. That is to say, if the gases are somewhat warm, the vacuum is not thereby reduced, as it would be in the case of our pump.

The whole plant being under vacuum, all the steam necessary for the still may be obtained from the exhaust of other engines in use on the works, so that the only live steam required (with the exception of the small jet referred to) is for the engine of the vacuum pump, and any other pump necessary for working the plant. But the exhaust steam from these can also be used. At Hamilton nothing but exhaust steam is employed in the still, and it is obtained from the exhausters and the engines of the tar and liquor pumps, along with that from the vacuum pump and a small Worthington pump used for circulating water through the condenser, which is of the tubular type. We take the water for this purpose from the tank of a gasholder near at hand, and put it into the tank again after it has passed through the condenser. The water is withdrawn from the bottom of the tank and returned at the top.

We find that not much more than half the exhaust steam of the works is required for the still, the temperature of which while working is from 75° to 78° C. at the steam inlet. This is a much lower temperature than that of an ordinary plant working under pressure, but, being under vacuum, the liquor boils, and the ammonia is driven off, at a considerably lower degree. The lower temperature also causes a much larger crystal to be formed. The supply of exhaust steam is regulated by valves which enable us to use whatever quantity may be needed for the plant. There is also a Tangye pump for taking away the waste liquor from the plant to an old gasholder tank so that it may be used for quenching coke, as we are not allowed by the County Council to run the waste liquor into the drains. But as this pump is one of the single action type, its exhaust steam is not available under vacuum.

The engine of the vacuum pump requires 2 cwt. of coke per ton of sulphate made to raise the necessary steam for driving it; and the two pumps and small jet require another 2 cwt. for their steam. Thus we have a total fuel consumption of 4 cwt. of coke to each ton of sulphate made, which is exceedingly low. We have tested the quantity of coke used by the boiler during a run of the sulphate plant, and compared it with that employed when the plant was not working, and we found it to be at the rate of 4 cwt. to each ton of sulphate. The plant makes from 2 to 2½ tons of sulphate per 24 hours, and the extra fuel used in boiler when the plant is working is from 8 to 10 cwts. of coke per 24 hours. With an ordinary plant we should have required the two pumps; so that for a consumption of 2 cwt. of coke per ton of sulphate made we get our vacuum which enables us to utilize the exhaust steam that would otherwise be passed into the atmosphere and lost. This saving in fuel is one of the particular features of the plant, and a strong recommendation for its adoption.

The vacuum on the pump and saturator in our case being from 22 to 24 inches of mercury, and that of the still from 13 to 15 inches, the wear and tear of the plant is evidently going to be very small. There is not the slightest sign of pitting to be found inside the saturator, notwithstanding a considerable amount of abuse it received during the experiments that were necessary during the earlier stages of developing the plant. With the vacuum there is a strong drawing away tendency of both gases and liquor from the sides of the vessels, whereas under pressure the action is the opposite—the gases and liquor being pressed or forced into the interior surface of the vessels, thereby causing more rapid wearing away of the metal. The life of an ordinary lead saturator working under pressure is generally found to be from two to three years, during which time it usually requires a considerable amount of repair. But we expect the copper one to last eight or ten years without repairs; so that, although it may cost more at first, it should be cheaper in the end, and cause less trouble.

The sulphate produced by this plant is of a very high quality, both in regard to the percentage of ammonia and to color. Some tests have shown as high as 25.70 per cent. of ammonia, and 25.20 is the lowest we have had. This is no doubt owing to the exceptionally large size of the crystals produced, which allows the salt to dryrapidly, and so contain only a very small percentage of moisture. The sulphate also remains in a very friable state when dry, and practically requires no breaking for filling into bags. Considerable time is therefore saved in this respect.

The whole of the operations of the plant are easy of manipulation, and cleanly in every way; and any man of ordinary intelligence can have no difficulty in learning to work it. The saturator being completely closed, no skimming is required; and the operator does not need to stand over a boiling vessel to skim off arsenic and other impurities. When the plant is not working, the engine and vacuum pump may be utilized for revivifying the oxide *in situ* in the purifiers. This is done by having a stopcock for the purpose at the back of the vacuum pump, by which air is drawn in, and then sent forward into the purifier. The quantity of air can be easily regulated, so that there is no risk of setting fire to the purifier grids, if wooden ones are in use. We have found this arrangement to work most satisfactorily, as it obviates a lot of handling of the oxide, and consequently is a saving of labor.

As the saturator is entirely closed, as already stated, we had to use acid commercially free from arsenic, which was expensive. This was a drawback to the plant, as the saving in fuel was more than swallowed up in the higher price we had to pay for the acid. But we have been able to devise a very simple, inexpensive, and easy method for using common tower acid. This is accomplished by passing the waste gases from the plant through the acid until all the arsenic has been precipitated as a sulphide, which is afterwards filtered out.

I do not feel at liberty to divulge the materials used in the filter or its construction; but the materials cost only a few shillings, and are easily obtained. There is not the least likelihood of a "corner" ever being formed in them. There is much more sulphuretted hydrogen in the waste gases than is necessary to precipitate all the arsenic it is possible to have in pyrites acid.

The arrangement for dealing with the acid consists of an overhead precipitating tank, to which the acid is elevated by a steam acid raiser in the usual manner. The gases are then passed through it until all the arsenic has been precipitated, which generally requires about three hours. From the precipitating tank, the acid gravitates to the filters at a lower level; and from these it flows into a storage tank, whence it is drawn into the saturator. From the precipitating tank, the waste gases pass on to the oxide purifiers. Samples of the sulphate made by the two kinds of acid are submitted; and it will be observed that that

made with the common tower acid after treatment is equally as good as that made with the dearer acid.

The foregoing remarks apply to what is called a "single-effect" plant, and is what we have at Hamilton, although it was at first intended to erect a "double-effect" plant. We found, however, the former to be quite large enough for our purpose. Where exhaust steam may not be available, or not sufficient, and live steam has to be used, a considerable saving will be further obtained by the double effect plant; as the waste gases from the first still and saturator, as shown on the drawing, are utilized for heating the liquor in the lower part of the second still. Only one superheater, condenser, and vacuum pump are required, and as practically double the quantity of liquor can be dealt with, and therefore double the quantity of sulphate made, it must be evident that the saving in fuel per ton of sulphate will be much greater in the double effect plant, besides a smaller floor space being required.

The principal features in the vacuum plant may be shortly stated as follows: Labor is reduced to a minimum, the exhaust steam which was allowed to go to waste is utilized and made profitable, and consequently a large saving in fuel is effected, and a first class sulphate, practically free from arsenic, is produced from the cheapest form of pyrites acid, which acid can be freed from its arsenic and filtered, without any reduction in its strength, at practically no cost for working expenses.

Discussion.

The President said he hoped there were a good many sulphate makers present, so that the paper might have a full discussion. If there were any there who had used saturators with any similar method for discharging the sulphate, he should like to have their opinion. He heard the other day of a plant for dealing with the waste gases where they were burnt in special furnaces washed with water, which was then run into a tank along with the effluent liquor from the stills. In this way, clear water was produced. He was told there was no difficulty in getting permission for this water to go into the sewers; but he should like to know something about the cyanogen in it.

Mr. J. P. Leather (Burnley) said this paper was certainly interesting to all who had anything to do with sulphate manufacture, though there might appear to be some points in which they could hardly see entirely with the author. He noticed that Mr. Ballantyne gave his reason for some of his results, which they were told the other day it was a dangerous thing to do. He made the assertion that the holes in the pipes in his saturator were not enlarged in the same way as they were in ordinary plants; and he said this was entirely due to their being under a vacuum, which allowed the gases to escape without any pressure. He must say he did not understand this. There was a pressure, even though there was a vacuum. That which wore a hole away by passing gases through it was the friction of the gases which had to pass through the holes whether under one pressure or under another. The saturator was of a somewhat uncommon type, being made of copper. The only ones he had ever seen of this make were under pressure. This one, being under a vacuum, was under rather different circumstances; and he should like Mr. Ballantyne to state what the strength of copper was, because, under such a vacuum as he spoke of, there might be a possibility of collapse, unless the plates were strong enough. One thing he spoke of as though it was an advantage, was the large size of the crystals of sulphate of ammonia, which to him was rather a surprise. He must say the sample sent round did not look as nice as crystals which were smaller. There was no comparison in whiteness with those he was in the habit of making—not because there was any color about the crystals, but because of the size of them. A large crystal did not look as white as a small one. At the same time, as long as it had such a percentage of ammonia in it, there might be no difficulty in getting rid of the sulphate. This was a little surprise to him also, because he had an impression that large crystals did not contain quite so much ammonia. They had made large crystals—occasionally an inch in diameter—but they did not generally find they could sell them. The great advantage of this plant seemed to be in the economy of fuel; but this would only apply where it was convenient to put it close to the point where the exhaust steam was available. If it had to be put where there was no exhaust steam at hand, the advantage would be lost, and the cost would be increased. The next point was that of the life of an ordinary lead saturator, which the author put down as from 2 to 3 years. He could only say that last year he took out a lead saturator which was new in 1873. It certainly had not worked all the time, being out of use for 3 years; but this left 26 years as its life. Mr. Ballantyne spoke of a life of 8 or 10 years for copper; but he (Mr. Leather) hoped it would last much longer. His experience was that lead saturators, properly made, would last a long time. There had been, during the last 6 or 8 years, a moderate amount of expenditure on repairs to the one he referred to; but for the first 15 or 16 years, it had very little repair. It was made in the early days of strong plate lead saturators, and he believed was made better than they were some few years later, though good ones were now manufactured. The author referred at the end to a double effect plant; but he did not gather whether it had been used. It seemed to him that one serious objection to it was that by putting the waste gases from the first saturator through the second still before the lime was added, the waste gases would come in contact with the limed liquor. They had found that, if they did not get rid of all the carbonic acid gas out of the liquor before adding lime, the still was soon choked up with carbonate of lime; and this, he thought, would be the result of the double effect system. He would also ask Mr. Ballantyne (if, as he understood him, he got rid of the arsenic in the strong liquor) what was the strength of the liquor through which he passed the gases in order to get rid of the arsenic. In the ordinary way, the arsenic was got out of the sulphuric acid after diluting it.

Mr. Walter Grafton (Beckton) said he should be glad to know the strength of the acid used, and the quantity of acid per ton of sulphate made.

Mr. J. Ferguson Bell (Derby) remarked that, having been permitted to inspect this plant some 18 months since, he should like to congratulate Mr. Ballantyne on making it a success, because when he inspected it he was not altogether satisfied, and it struck him as being very complicated. The difference between this plant and the ordinary one was that Mr. Ballantyne worked under a vacuum, and, of course, by this means saved fuel. But the question occurred to him whether the complications and extra expense would not more than counterbalance the saving. Most gas works raised steam at a very low cost—in their case, they estimated about 2s. per ton of sulphate sold as the cost of fuel, because they used only breeze for generating steam. This plant was very similar to others; the only special feature being the vacuum. One point brought forward was the overhead saturator. He had been working with one of this kind for some 12 months; and he could thoroughly recommend it, as very much less labor was involved. Of course, the sulphate fell down by gravity; and the only thing that had to be done was to open the valve every 4 or 5 hours, when it was dropped into the wagon, and wheeled into the sulphate stores. They worked the saturator with liquid of about 56° to 58° Twaddel; and, strange to say, their salt came out very dry and very hot, and in a few hours was practically dry enough to be put into the bags and sold, if necessary. In their case, the saturator was formed of cast iron plates lined with lead ¼ inch thick. He did not think the author was quite correct in giving the life of a lead saturator as only 2 or 3 years. His experience was that it was more like 10 years. At the end of this time, the lead was almost of the value of new; the only thing lost was the labor in making another saturator. There was one point about taking the arsenic out of the acid which he should like to have explained. A great many people used pyrites acid, from which the manufacturers took out the arsenic first; and the question occurred to him whether the manufacturers could not take the arsenic out cheaper than they could. Mr. Ballantyne had not given any figures showing the cost of working, or of plant, or of repairs; and it all came to a question of *l. s. d.* The plant at Derby was a Colson, with an overhead saturator, which answered very well; and they had few repairs. When he inspected the plant at Hamilton, he came away with the firm conviction that it was much more complicated than his own, and could not recommend his Board to adopt it; but meantime Mr. Ballantyne might have considerably simplified it and improved the results.

Mr. R. G. Shadbolt (Grantham) said there were one or two sulphate makers present who had been comparing notes; and they would like to know whether the total yield of sulphate per ton of coal carbonized was any greater by this method than that obtained by the ordinary process.

Mr. Robert Watson (Doncaster) asked if Mr. Ballantyne would give the strength of the waste liquor. The worth of the whole process seemed to depend upon the value of the ammoniacal liquor.

Mr. J. H. Troughton (Newmarket) said he should like to ask Mr. Ballantyne whether he found any nuisance arising from quenching the coke with the effluent liquor, and also if he could give them any definite data as to the number of times the draw-off valve at bottom of the saturator became stopped, or if he had any trouble from that cause.

Mr. J. W. Helps (Croydon) said he had had some experience in sulphate making with a great variety of plants during the last 25 years; and he should like to congratulate Mr. Ballantyne on his paper. At the same time, he could not help thinking it was a pity that he was not in a position to give some figures as to the cost of making sulphate by

this new process as compared with, and the results obtained by, what may be termed the ordinary types. He agreed to a great extent with what Mr. Bell said; for the plant did appear to him, from the description and the drawings, to be somewhat complicated as compared with the old friends with which he was well acquainted, and which had given very good results in the past. Mr. Bell was perfectly right in saying that the cost of production of steam in gas works was not very important, though, of course, every shilling saved was worth having. He could not quite reach a figure of 2s. per ton as the cost of fuel for sulphate making; but they got somewhere near to it. With regard to this process, it appeared that, beyond its novelty, the great claim made was that it was possible to use exhaust steam; but it seemed to him, knowing the amount of steam that had to be employed in making sulphate, that it was within the bounds of possibility they might have to put down some machinery to produce the exhaust steam. On their own works, they had a good many condensing engines; and the exhaust steam available would be scarcely sufficient to do all the work which would be necessary. They must not forget, also, that this plant necessitated the use of an engine and exhauster for producing the vacuum; and that machinery would require steam as well. If they took into consideration the large amount of extra capital which must be necessary to put down such a complicated plant, and the sum required for doing certain other extra work, he imagined there would be very little saving in the end, He thought Mr. Ballantyne possibly would, if he had had experience of sulphate making at Hamilton with other processes, be able to give some figures as to what the *l. s. d.* advantages of this system might be over those he had previously used.

Mr. R. Bruce Anderson (London) suggested that Mr. Ballantyne might with advantage peruse the papers read before the Gas Institute in 1887, with the compiling of which he had something to do, having conducted some of the experiments with the late Colonel Croll. Having put down a reciprocating exhauster, they drew the products of combustion from the furnace through a Coffey still, and then passed the products through a saturator of the open type. The mechanical arrangements were very adverse to getting advantageous results; but at the time they concluded that they got an increased yield of sulphate of ammonia per ton. Where it came from, however, they could not exactly ascertain. Mr. Ballantyne, with his vastly improved apparatus having these overhead saturators, and having an exhauster which did not cause oscillation so much as a reciprocating one, would have an opportunity of verifying and repeating the experiments tried by Colonel Croll and himself.

Mr. Ballantyne, in reply, said with reference to the holes in the distributers of the saturators, he spoke from personal observation, because he had had experience of sulphate making for the last twenty years; and his experience was that, with ordinary lead saturators, the holes got torn away in a very short time indeed, and widened. No doubt, as Mr. Leather pointed out, there was friction with gases under a vacuum as well as under pressure; but being under a vacuum, the friction must be much less, and therefore the destruction of the holes could not be so great or so rapid. The thickness of the copper in the saturator was ¼ inch. The percentage of ammonia in the sulphate had been tested a great many times; and they found there was a keen demand for it—most of it being bought up for shipment to the West Indies direct. He considered that, unless there was something special about it, the demand would not have been so keen, and the sulphate not have been sent so far. They sold it according to sample; and the brokers seemed most anxious to get it. He rather thought one of the reasons was the freedom from moisture, because of the large crystals, which did not destroy the bags in which it was packed to the same extent as ordinary sulphate. They got an additional price for the extra percentage of ammonia. With regard to the life of lead saturators, he also spoke from experience. In Rothesay, where they erected new works and new sulphate plant, a lead saturator was put in by one of the best makers in Scotland, and at the end of two years it was so weakened by contraction and the heat that it simply tore away at the corners and had to be repaired. At the end of 3½ years, it had to be renewed. The lead was not worn; it was simply torn away, and became so contorted that it was past repair and had to be replaced by a new one. He understood that cast lead saturators did last longer; but he had not had any experience of them. With solid plate lead ones, his experience was they did not last anything like the time Mr. Leather said; and he thought he must have had an extra good one, made in some special way—quite different to those they got at the present time in Scotland. He knew of another works not very far away where a lead saturator had been in use for not much more than three years; and it had to be renewed quite recently. The double-effect plan had not been in use as yet in any works. This was the first plant of its kind ever erected. It took a long time to develop; and the double-effect plant had not been in use as yet in any works. This was the first plant of its kind ever erected. It took a long time to develop; and the double-effect plant had not been put into actual practice. How it would work, he could not tell. The idea was, if possible, to utilize the heat in the waste gases for further distillation; and for this purpose, of course, the the plant was very suitable, if it could be done. With regard to the strength of the acid, they did not reduce it at all; it was 144° Twaddel, common chamber acid, not diluted in any way. The makers who supplied them with the special acid were quite surprised that they were able to thoroughly eliminate all the arsenic without lowering its strength. They said they had to reduce it; and he understood that all makers had to do so, for the simple reason that they had to purchase the sulphide of iron to make sulphuretted hydrogen with which to precipitate the arsenic in the acid. In gas works, they had sulphuretted hydrogen in the waste gas, and it was a means of using it up, and also saving the purifiers. But acid makers reduced their acid down to a certain strength, so as to take the arsenic out of it more readily, and so as not to waste the sulphuretted hydrogen they had to make. The reduction of the strength of the acid was simply from the commercial point of view. They found there was no difficulty whatever in taking it out at full strength, because there was plenty of sulphuretted hydrogen in the gas. They simply allowed it to run through until all the arsenic was precipitated. When Mr. Bell saw the plant, he must confess that it was in a very crude state. It was simply a network of pipes, more like a spider's web than anything else. But at the time they were also trying an experiment to use the sulphuretted hydrogen, to catch it up with the sulphate of iron, in order to utilize it for a commercial purpose. The experiment, however, was a failure. The apparatus was in that stage when Mr. Bell saw it; and, of course, it necessitated a great many pipes, and made the plant look very complicated indeed. In its present state, all these pipes had been done away with. Everything was shown on the drawing, except the steam pipes leading to the plant. They used coke breeze in the boilers, but had not enough to keep up steam altogether, and in this way there was a saving, because where one had to use coke there must be a considerable saving on this head. Where coke breeze was plentiful, the saving would not be so large; but yet it was not necessary to use so much of it. It was possible to use up the exhaust steam. Of course, if there was no exhaust steam, it altered the question; but in the majority of works the exhaust steam was not condensed—it passed into the atmosphere and was wasted. With this plant, it could be turned to some good account, thereby saving not only fuel but labor as well. He had refrained from giving the cost of working, because it varied very much in different places. The great part of the cost was really the price at which the acid could be purchased. In one district it might be bought at 30s.; whereas in another it might be necessary to pay 40s. or even 50s., or, again, it might be got for 25s. It was, therefore, almost impossible to give the average cost of the process.

Mr. Helps asked if Mr. Ballantyne could give the cost as compared with making the sulphate in his own district under the old processes.

Mr. Ballantyne replied that most of them used pan acid, not chamber acid. The acid was distilled in a platinum still, and part of the arsenic taken out; and this acid would cost somewhere about 45s. to 50s. They could buy common chamber or tower acid at 30s. to 35s., and get the same result; so that they actually had a saving of about 15s. per ton in the sulphate made by using common, cheap acid, as compared with partially refined acid. With regard to the quantity of ammonia taken out, he had not had a complete year's working, and was not able to state the amount; but, as near as he could make out, last year it would run about 30 pounds of sulphate to the ton of coal carbonized, and this without taking out the fixed ammonia. In Scotch liquors, the fixed ammonia was a very small quantity, and did not more than pay the expense of taking it out; whereas with English liquor, he understood the fixed ammonia was from four to six times as great. With regard to quenching the coke with the spent liquor, this was, in fact, the only thing they could do with it, as they were not allowed, under any conditions whatever, to put it into the drains. There was a slight smell from the steam; but by making high enough quenching towers, it could be carried up into the atmosphere, and in this way any nuisance from the steam could be to a great extent overcome. The waste liquor was raised to an overhead tank by a pump, and then passed down into an old gasholder tank at the bottom, where the coke was quenched, and it was kept circulating between the overhead tank and the one at the bottom. He found that with this form of plant a man could do more work than with the ordinary plant, espe-

cially if he had to fish the sulphate out. With the vacuum plant, he had nothing to do but to open the discharger and take out the salt, and then go about and look after the valves and gauges, which was a very simple thing. He could see the whole operation from the floor, because there was a mirror put on at the top of the side glass to enable him to see the height of the liquor. In fact, the whole operation could be perfectly seen. With two men during the summer, they made this quantity of sulphate, or three men in the winter; but these men could make double the quantity of salt. If the still were big enough, and he had sufficient liquor to employ larger plant, the same amount of labor would produce double the quantity. It required about 19½ cwt. of acid to the ton of sulphate.

The Making of Specifications.

[Address of Dr. C. B. Dudley, Altoona, Pa., Pres. Am. Society for Testing Materials.]

It has occurred to us that in the present state of development of our society it might not be amiss to discuss some points in the making of specifications for materials. If we understand the matter correctly there is more or less doubt and ambiguity in the minds of many, and while it is not hoped or expected that the present discussion will put the whole matter at rest, it is believed that it will serve some valuable purpose to have on record an attempt at a presentation of the case as it looks to one who has spent over 20 years in daily contact with practical specifications for materials.

It has occurred to us that it might be useful and valuable to give an *exposé* somewhat in detail of the methods practiced at Altoona in connection with the laboratory of the Pennsylvania Railroad in making specifications. The general plan which we have at Altoona is as follows: First, we try to find out what we want. Some difficulty arises in the service; some parts of construction fail, and an investigation is made to see if the cause of the failure can be located; or some product which is being largely used, and which is being furnished by different makers, is believed not to be of equal quality from the different sources; or indeed it is desired to standardize a practice and make it uniform all over the road, and as an element of this problem the same quality of material must be furnished and used. These and other elements lead us to make investigations into the nature of the commercial products involved. These investigations lead to specifications. The specifications after being made are placed in the hands of the purchasing agent, and by him are made a part of the contract on which the materials are bought. Shipments of material in accordance with this contract being received, each shipment or specified definite amount is sampled and the samples examined in accordance with the specifications. If the samples stand test the material is accepted and paid for; if not the material is rejected and returned to the makers. This plan has been in daily use at Altoona in connection with the Pennsylvania Railroad for something over 20 years. The number of specifications, both physical and chemical, is 47.

Defining the Quality of Material.—Now how shall a specification be made? It is quite obvious from the nature of the case that primarily in a specification two parties are interested—the producer of the material and the buyer or consumer—and in our first specifications only the relation of these two parties was considered. Indeed, we were accustomed to say for quite a period of time that a specification was an attempt on the part of the consumer to tell the producer what he wanted. It necessarily followed from this limitation that the first specifications did little more than define the qualities of the material. It is true that methods of sampling, how much material one sample shall represent, and in some cases methods of testing, either in whole or in part, may wisely be embodied in a general specification; but it is obvious that all those features of a specification which have to do with local conditions cannot well be made a part of a general specification.

As has already been said, at first our specifications considered almost exclusively the two principal parties involved—namely the producer and the consumer—but as time progressed it was found desirable and advantageous to consider several other parties, who were or might be involved in the matter. Questions began to arise as to how much material should be involved in one test. Then came the question, Would it be advisable to buy in lots of the same size as the test involves? Then came the question of sampling. Then came the question, Shall part of the work of deciding whether shipments fill the requirements be done at the works where the material is made, or shall it all be done after the shipment is received? If the former, an inspector is involved, and he must have information which could perhaps best be embodied in the specification itself. Furthermore, those who actually applied the tests, the chemist and the engineer of tests, would frequently ask questions in regard to methods, or interpretation of various points, and finally it was found that those who ultimately receive the material, such as the storekeeper or shop foreman, could frequently make certain inspections, better perhaps and cheaper than anyone else, and so information must be furnished for them. This necessity for information for the use of a number of different parties has made the modern fairly workable specification for certain materials to be a somewhat lengthy and at times a seemingly cumbrous affair. It is difficult to draw the line as to exactly what should be included and what excluded in a specification. The commercial interests of the manufacturer on one side and the zeal, sometimes excessive, it must be confessed, on the other side, on the part of the inspector or chemist or engineer of tests, led to very close scrutiny of the wording of the specification, and it cannot be denied that many times conditions arise which make those who are deciding the fate of shipments wish that the specification had been more minutely drawn. In drawing a specification one is always between two fires, the fear of making a specification too cumbrous and unwieldy, and fear of leaving out something which will be found desirable or even essential a little later.

What is Needed?—As far as we can be said to have reached a positive conclusion at Altoona, it may perhaps be embodied in this, that a good workable specification should contain such information as is needed by the purchasing agent, such information as is needed by the manufacturer, by the inspector, by the chemist, by the engineer of tests and by the people who are to receive and use the material. This view of the case will undoubtedly be conceded by all, but the exact amount of information covered by the word "needed," is where the difficulty arises. For example, should the specification cover the chemical method involved in the analysis of the material? Should it cover the methods of testing? Should it cover the complete instructions for the inspector, meeting every point, and so on. Upon this point our views are that the specification should not attempt so much. Where methods of analysis, or methods of testing, or points which the inspector must look out for, are well known, or can be covered in general language, it is sufficient to do this only. Where new methods are involved, which are not well known and recognized, it is essential to either embody these in the specification, or to furnish this information in separate form, and refer to it in the specification. This is common practice, as is well known, in referring to drawings, blue prints, etc., and it may not be amiss at this point to state that in view of the difficulties connected with discrepancies in chemical analyses we began several years ago to print and issue in separate form the methods used in our laboratory, making these methods a part of the specifications by reference only, and thus also a part of the contract. The same practice has prevailed elsewhere in regard to methods of physical testing, and it is our sincere hope that sooner or later our society will issue in printed form what it recognizes as standard methods of testing. Such work well and carefully done will relieve specifications of much which they must now necessarily contain.

Faults of Specifications.—This, perhaps, is the place to discuss one or two faults characteristic of many specifications which we have seen. We will not attempt to deny that in our earlier work on this subject the same faults characterized our specifications. They are in print and may be read and known by all. The special fault which characterizes many specifications is the attempt on the part of the one who draws the specification to make it a place to show how much he knows. We have seen specifications which were apparently drawn with no other thought in mind than to embody all the knowledge the writer had on the subject. No discussion is needed on this point. The folly of it is apparent to all.

Another fault is in putting too many restrictions into the specifications. According to our views, the fewer possible restrictions that a specification can contain, and at the same time afford the necessary protection in regard to the quality of the material, the better the specification is. In some of our specifications we have only one test; in others perhaps half a dozen; the effort, however, being always to have the minimum number which will yield the product that is required.

A third fault in specifications is in making the limits too severe. Some writers who draw specifications apparently put themselves in position of absolute antagonism to those who are to make the material, and seem to have as a permanent thought in their minds to tie them down to the extreme limit. The maximum that a single test piece shows, the minimum of an objectionable constituent that may be obtained by analysis, the extreme point in elongation that by chance some good and exceptional sample gives are made to represent the total output of the works. It is, perhaps, needless to say that such extreme fig-

ures are the worst possible mistake in making specifications. The success or failure of structures or of material in service does not depend on such extreme figures. It is infinitely better to specify a good average material, and get the necessary protection in structures by a more liberal factor of safety in the design than to insist on such extreme limits, which can only lead to constant friction and demand for concessions at the penalty of delaying the work.

Criticism of Proposed Specifications by Manufacturers.—This submission of a specification to the manufacturers before it is issued is a matter of the utmost importance. In the early days our idea was to tell the manufacturers what we want. We were the parties to define the material, and it was their part to simply give us what we asked for. At the present time our idea is that the specification should be the embodiment of the best that is known on the subject, no matter where the information comes from, and that it is simply the part of wisdom, and that we are not only foolish but shortsighted and unfair if we attempt to make a specification without at least giving the manufacturers an opportunity to co-operate. We feel that the specification should be regarded as partly his creation as well as ours, and that he should be able to see his own handiwork in it. We are free to put on record that to the co-operation and help of the manufacturers of materials quite a portion of the success, if any, that has attended the Pennsylvania Railroad specifications has been due.

The criticisms from all sources having been received the specification is carefully gone over again in the light of these criticisms. As far as possible the valid and valuable suggestions of all are embodied. Conflicting criticisms, many times due to local conditions, are harmonized as well as may be, and the specification as redrawn and modified is then submitted to the proper officers for approval, and ultimately issued and made a part of the contract on which materials are furnished, as has already been described.

As already stated, it is not hoped or expected that the processes and methods made use of in the making of specifications by the Pennsylvania Railroad can be followed in minute detail by others in making specifications, and yet there is a single thought upon this phase of the case which seems to us worthy of careful consideration—namely, the greater the care the larger the amount of study, and the more well directed time and effort that are put upon the specification before it is issued the less will probably be the difficulty connected with it after it has once become a part of the contract. To our minds the making of successful specifications demands more ability and a higher order of work than has heretofore been commonly given to it. The valuable specification represents the fruition of the studies of those who make investigation into the properties of useful materials and of those who use them, and in reality it is the culmination of the work of our society.

Chemical Specifications.—As we understand the matter, there is opposition on the part of the manufacturers of steel to having the consumer put out chemical specifications in detail. It is claimed that the consumer should only specify the physical properties of the metal, and exclude or limit by the chemistry only constituents which are objectionable, leaving the steel maker free to vary those constituents, upon which the most valuable properties of the metal depend, according to his own ideas. This feeling, if we are rightly informed, is much stronger abroad than it is with us, and we have been told that steel makers abroad would not bid on a specification of which complete chemical requirements were a part. The position which we hold in the matter is that a certain set of physical properties produced by, for example, high carbon and low manganese, may give a steel more valuable to the consumer than approximately the same physical properties produced by lower carbon and higher manganese, or other interchange of the constituents commonly affecting the physical properties of steel. Moreover, we cannot help feeling that the chance to study the behavior of metal in service and the relations between its chemical composition and that behavior is a source of information which should not be ignored. No one can deny that this chance is more open to the consumer than to the producer, and we fail to see why the producer should shut himself out from this source of knowledge. As has already been stated 2 or 3 times, in our judgment a good specification is the result of the joint effort both of those who know steel from its behavior while it is being manufactured and of those who know steel from its behavior while in service.

Sampling and Averages.—We have found it difficult in our work to make any definite rule universally applicable as to how much material should be represented by one sample. Where materials are made in batches or in heats, and the sample is selected at random, no serious difficulty has thus far arisen in making one sample represent a heat or batch. Where a shipment, as in the manufacture of alloys, may be made of material resulting from a number of like operations without any certainty as to uniformity in the output of each complete operation, the question of sampling is more difficult. The same may be said of oils and paints and other related materials. In such cases it is usually customary with us to make an arbitrary sampling and to follow this sampling by occasional more complete sampling after the material has been received and passed upon. If such more complete sampling shows lack of uniformity in the shipment of material involved it may not infrequently lead to a modification of the specification.

Closely related to the question of the amount represented by one sample is how many individual parts shall make up the average sample. For example, shall one ingot represent 20,000 pounds of an alloy, or shall more than one? In a shipment of oil shall a sample from one barrel be used, or shall smaller samples from each barrel be mixed to form one average sample? Our practice has been to limit the number of sub-samples entering into the average sample as much as possible, on the ground that the material should be uniform, and that the specification provides wide enough limits to make up for the ordinary variations, where the manufacturing or shop practices are reasonably good. If the material is uniform, or all of it within the limits of the specification, the multiplication of sub-samples really serves no useful purpose, and as we really buy and pay for a material described by the specification, it is not unfair to expect that any and every part of it should be in accordance with that specification.

(To be Concluded)

Coal Mining In Ohio.

According to the preliminary report of State Mine Inspector G. E. Eillison the total coal mined in the State of Ohio in the year 1902 was 23,926,267 tons; a gain of 3,607,477 tons, or 17.8 per cent. over the output for 1901. Production last year was stimulated by the shortage of anthracite, as well as by the demands of an active manufacturing industry. On the other hand, operations were restricted at many mines by the failure of the railroads to furnish transportation for the coal as fast as it was needed. The large production in 1902 probably puts Ohio third on the list of coal-producing States for the year. Its output was exceeded by that of Pennsylvania and Illinois only; in 1901 it stood fourth, being passed by West Virginia also.

In 1902 coal was mined in 30 counties of the State. The total number of mines, or openings, reported to the inspector was 967; of which 906 were in operation, 61 being in throughout the year. Probably most of these are exhausted.

Of the different sections of the State, Athens county ranks first as a coal producing county, the entire output amounting to 3,666,993 tons; this is a gain of 600,460 tons over the output for 1903. Guernsey county ranks second in point of production reporting a total tonnage of 2,968,108 tons, a gain of 876,221. Perry county, which in 1901 ranked second, dropped to third position in point of production, having an output of 2,830,962; however, there was a gain of 267,911 over the preceding year. Jackson county, a former noted coal producer, occupies fourth place in the amount of coal produced, reporting a total of 2,316 123 tons mined. The gain over 1901 was 174,657. Hocking dropped from third place to fifth, producing 2,118,805 tons, which was a loss of 230,064. Belmont county is the sixth in point of production, mining 2,058,066 tons, a gain of 513,214 tons. One county produced over three millions, and five over two millions. Gains occur in 21 counties, and losses in nine. The Hocking Valley District, which is composed of the counties of Hocking, Athens and Perry, produced 8,616,760 tons, or 37.7 per cent. of the entire output of the State. This is a gain of 638,327 tons, as compared with the year 1901.

The total number of persons employed in coal mining was 37,421, of whom 27,613 are classed as miners, and 9,808 as day hands or laborers. This shows an average of 639 tons per employee, or 866 tons per miner. The average time worked for all the mines was 176.4 days during the year.

There were 141 mines in the State, in which machines were in use. The total coal mined by machine was 13,439,648 tons, or 56.2 per cent. of the total. These figures show that machine mining has a stronger hold in Ohio than in any other State; also that it is in the larger mines where machines are used. The number of machines of all kinds at work last year was 574, an increase of 145 over 1901. These required 1,418 machine runners and 11,889 helpers, laborers and other assistants.

The accident report shows the following statement of persons killed and injured in Ohio mines during the year:

Results.	Number.	Per 1,000 Employees.	Per 1,000 Days' Work.
Killed	81	2.16	0.012
Seriously injured	298	7.96	0.045
Slightly injured	153	4.09	0.023
Total injured	451	12 05	0.068
Total	532	14.21	0.080

The number per 1,000 days' work is, of course, an approximation, based on the average term of operation in the mines, which is given above.

In addition to the coal mined in Ohio, there were 10,681 tons of iron ore produced, and 1,528,829 tons of fireclay. The mining of iron ore in the State has fallen to a very low point.

New Machines for Old.

[By Mr. C. E. Brackenbury, in *Journal of Gas Lighting*.]

Quite recently it has been my privilege to see, in actual operation, one of the largest and most complete installations of inclined retorts in the world, and also both the new systems of machinery for horizontal retorts, which have been so fully and interestingly described lately in the columns of the *Journal*. The articles referred to have, I know, met with wide appreciation; and when at the Paris Gas Company's offices, great satisfaction was expressed by the engineers at the eulogies that have been passed upon them and their work. I should like to be allowed to add my meed of praise, and at the same time to express my thanks to MM. Bertrand, Euchène, Gigot, Auburn (the Superintendent of La Villette Gas-Works), and others for their many acts of courtesy, and for the information they so willingly gave. On the date of my visit, there was quite a little international gathering of engineers, as Mr. Edward Drory, of Berlin, and other gentlemen were also inspecting the turbine machines at the same time. It would be of great interest to have all their different views on what was shown them.

"Well, what do you think of the machines?" is a question that has been put to me several times since my return; and it is in the hope of conveying some impression of those thoughts that I write these lines. The opinions that I have seen thus far expressed vary from the wisely cautious to the wildly enthusiastic. "Inclines are dead; long live machines" seems to be the cry of some. It would appear to be difficult in the face of any novelty, or the introduction of any new process, or the formulating of any new proposal, to avoid being unduly optimistic and claiming too much on the one side, or unnecessarily pessimistic and denying too much on the other. I am desirous of erring in neither direction. My faith in inclined retorts in suitable cases, is not so feebly founded as to be lightly shaken by the first breath of a centrifugal charger. My high opinion of West's compressed-air stoking machinery and Arrol-Foulis hydraulic machines, in suitable cases, is not shattered by the introduction of an electric turbine or projector.

On the other hand, I fully recognize the labor-saving possibilities and cost producing probabilities of the Paris machines; and I thoroughly appreciate the beautiful simplicity and lessened expenses of the Bruges belt. But I am afraid that I have not been gifted with the happy mutability (say) of Mr. F. D. Marshall, who, in 1898, "comparing the inclined system with power stoking, argued that everything, including common sense, pointed in favor of the former plan," yet, in 1903, "metes out conscientious and unqualified praise on a machine stoker." He who, in 1898, described power stoking as "turning an otherwise decent-looking retort-house into something between a pit-head and a machine shop," might add, in 1903, were he the same Mr. Marshall, "electric tram and ship's turret." In 1898, "he had had a mechanical stoker; but after some time he determined it should be the last." In 1903, Mr. Marshall "is so convinced of their (machines') superiority, that he has secured from the Paris Gas Company the British and Colonial rights in the invention." No! the metamorphosis of Mr. Marshall in five short years certainly does "seem a trifle odd." *Tempora mutantur* is all very well, but this is *tempora mutantur* with a vengeance!

For my own part, I gladly see in the introduction of these new machines indications of progress—but not of revolution. The margin of advantage hitherto held by the inclined system of carbonization over the horizontal, may very possibly be reduced; but it is certainly not wiped out. The gulf between the two may have been lessened; but it has not been bridged. Some considerations that have led to the forming of this opinion, and a few other notes, may perhaps be given.

It must not be overlooked that the machines and their accessory plant in the present stage are more or less experimental. The second turbine charger is a very different machine from the first—with modified coal hopper and feed, and with the turbine motor rising and falling according to the tier of retorts to be charged, instead of being stationary as before. At the time of my visit, the first type of charging machine at La Villette was being thoroughly overhauled and modified after twelve months' continuous work. The De Brouwer charger is likewise, I understand, subject to modified arrangements of pulleys, having either two or three; and also the material of them, and of the flywheel, may be changed, wood having been suggested. I mention these points merely to show the somewhat embryonic state of the machines, and to bring home the fact that we are not discussing any definite, hard-and-fast apparatus, but something liable to distinct alteration—and I trust, improvement. These new machines will vary according to the conditions of their installation just as the old ones have done. Also it must be borne in mind, as wisely pointed out in the *Journal* articles, that the accessory plant up to the present has been of a very tentative character. The cost and difficulty of getting coal to the charging machine, and coke away from the drawing or pushing machine, are often far greater and more expensive problems than the mere charging and discharging operations themselves.

I do not quite see where any economy is likely to be effected by the new arrangements in this particular. The same amount of coal (or even greater) has to be broken, elevated, conveyed and stored, either in continuous or central hoppers, just as was formerly the case; but now it has all to be concentrated on one side only of the retort bench. The same applies to the coke, which has to be got away in equal (or larger) quantities as before, with the only difference that it will be in one stream instead of two. The accessory apparatus for these new machines may therefore be expected to approach in character that required for inclined retort installations. Particularly is this the case with the De Brouwer projector. The same breaker, elevator, conveyor, continuous hopper in all probability, certainly the same measuring chambers and the very levers, absolutely the same as for inclined retorts, but *plus* a machine—or is it going to be two machines? For a charging machine alone can hardly be considered as enough in itself, however simple and excellent it may be; it is but a part, and a small part, of the whole. It is like offering a man who wants both horse and cart, the cart alone.

We now come to the question of first costs. At this early period, I consider it somewhat premature to enlarge on what must of necessity partake more or less of the nature of vague estimates. I only mention them to call attention to a curious coincidence. The issue of the *Journal* which contained Mr. Marshall's comparative statement on the subject also recorded figures of a similar comparison made by M. Frère at the recent Société Technique Congress. The translated results are interesting, if nothing more—

Mr. Marshall's cost for installing the inclined system, per 1,000 cubic feet of gas made per 24 hours	£21 13 0
M. Frère's cost for installing the inclined system, per 1,000 cubic feet of gas made per 24 hours	10 15 0
Mr. Marshall's cost for the turbine system, per 1,000 cubic feet of gas made per 24 hours	17 8 8
M. Frère's cost for the De Brouwer system, per 1,000 cubic feet of gas made per 24 hours	11 7 0

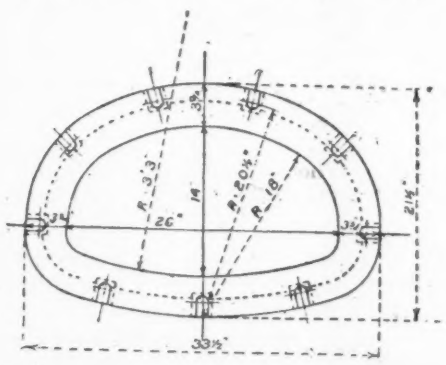
The power for driving both the new types of machines is electrical; and this is a feature I welcome very cordially, as I have advocated it, and the more general use of electricity for light and power in gas works, more than once in the past three or four years, on account of its adaptability, speed and cleanliness, etc. It has met with opposition. I seem to remember a recognized head of the gas industry once saying something to the effect that gas, and gas alone, had been good enough for him, as it had also been for his father before him. Mr. Charles Hunt also recently advised the Midland Gas Managers' Association to "let electricity alone." But I gather that he referred to it more parttcularly as an illuminant; and perhaps he would not have the same objection to using it for motive purposes, even within the precincts of a gas works itself. To Mr. J. D. Ashworth, however, "the use of electricity in gas works seemed like taking the bread out of their own mouths. He should never advocate that." I myself do not believe in this false protection policy; and if gas and gas works' material can be better and more cheaply made and handled by the adoption of electricity in any form, it seems to me obviously advantageous to use it.

I hope to see, therefore, as one result of the introduction of these electrically-driven machines, the breaking down of the narrow-minded, short-sighted prejudice, no doubt existing in some quarters, against the

employment of electricity in gas works. I look forward to the regular establishing of electrical equipment in gas works; the power required varying, of course, greatly according to the arrangements adopted. The power needed for coal and coke apparatus for similar-sized plants on whatever system may be taken as identical. Inclined retort charging requires the power of a man's hand. The Bruges belt takes about 3-horse power. The Parisian turbine wants, I believe, 24-horse power, if not more; and the pusher, 12-horse power. For machine charging a combination of the De Brouwer projector with the Paris ram immediately suggests itself as feasible in practice and economical in power—provided always that the lightness and simplicity of the former be not compromised by adding this or that to it, such as a coal hopper, and its framework and weight and rails and traveling and raising motors, etc. If all these additions to the machine ever be made, then "good-bye" to its attraction, simplicity, and cheapness; and I believe that, on comparing all the machines, both old and new, fashioned on the same plan, there will prove to be very little difference, weight for weight, work for work, men for men, and cost for cost, between water, air, belt and turbine.

Something has been heard of the speed of charging realized by the new machines. One claimant quotes 240 retorts per hour—that is, 5,760 retorts per twenty-four hours on continuous working, which is equivalent to a retort house over three times the size of that (say) at Windsor Street, Birmingham, or East Greenwich. Are not such figures futile? What purpose do they serve? The speed of charging is limited by the speed of drawing or pushing, which is, again, oftentimes limited by the speed of coke conveying. Then there is the time for coal receiving, and often for producer filling; so that to state barely that a retort can be charged in so many seconds answers no practical purpose whatsoever. Then, again, how many works are there large enough to find full employment for even the slowest of stoking machines? Besides all this, I myself have seen a West air-compressed machine, in ordinary work, charge and draw complete 42 retorts in one minute under the half-hour; while at East Greenwich the rope-driven machines, I believe, do 700 retorts in 12 hours, or 720 minutes. It is true that, with one pair of machines, instead of two, the duty per machine is increased, but the number of retorts served within a given time is not.

The form of the retort is of great importance. The most general Continental section (which I have often described and advocated) is a shallow ⏛, either with flat or curved bottom, 65 cm. wide by 35 cm. deep, or about 25⅝ inches by 13¾ inches. Its carbonizing qualities are excellent. Whether the floor of the retort be curved or flat is, as M. Euchène remarked to me, "*une chose de sentiment.*" Even among the Paris Gas Company's engineers, some prefer the one form, and some the other. The Paris retorts, as is known, are corrugated; being between 50 and



60 mm. (2 inches and 2⅜ inches) thick, and considerable saving in fuel is reported from their use. But this is a digression. The shallow section of the retort renders all but compulsory the adoption of a ram for discharging the coke, if stoking machinery is to be installed. I have worked the ordinary drawing machine rake with such retorts; but the result was that the charges of coal had to be reduced from those formerly put in by hand, so as to allow more clearance for the passing of the rake head between the top of the coke and the roof of the retort. Eventually, the retorts were slightly increased in depth, so as to reduce the difficulties encountered.

The second type of turbine machine and discharging ram at La Villette is now working only on an experimental bed of retorts, having the same dimensions as usual (65 cm. by 35 cm.), but made rectangular, with a view to putting in increased charges. M. Euchène, however, informed me that their experience was that it was not advisable to increase the weight of coal beyond a certain reasonable quantity, and that, therefore, they would retain the usual shape of retort, with the usual average charges of about 350 kilos. of coal (7 cwt.). Undoubtedly, as Mr. Charles Carpenter surmises, the shape of the Paris retorts tends to facilitate the discharging; and if the same weight of the same coal were to be put into an ordinary English section of retort, I should not anticipate the same good result. If the heats were identical in the two cases, the French charge would be the better burnt off, owing to the wider retort and thinner layer of coal. And as generally the heats abroad are much higher than at home, there will be these two points—temperature and shape of retorts—that will require to be carefully watched in any estimates, and allowed for in anticipating results.

Mr. Marshall, in his calculation of the cost of carbonizing with the turbine machine, quite light-heartedly takes as his unit the extraordinarily heavy charge of 1,300 pounds, which is over 11½ cwt., or 590 kilos. Of what elastic material are his retorts to be made, and at what wonderful heats is he going to carbonize? The average charge per 20-foot retort in 16 English gas works, which I recently had the privilege of visiting, was only 743 pounds, or about 6½ cwt., or 337 kilos. In the splendid carbonizing, wide and shallow Continental retort, one can distil, under favorable conditions, 400 kilos (8 cwt.) of Durham coal in six hours, and, very occasionally, even 450 kilos. (9 cwt.). But, as I have experienced, this latter amount is altogether out of the question in normal working with English-shaped retorts—say, 22 inches by 16 inches. What, then, is going to happen to Mr. Marshall's charge of 11½ cwt. or 590 kilos.—an increase of nearly 50 per cent. above the Continental average, and of 75 per cent. above the English one? It must certainly be confessed that his charge is an astonishingly high one, and consequently, his cost result an "astonishingly low one!"

Engineers and contractors are generally too sanguine as to the first cost of any installation, and as to the working expenses, and as to the number of men to be employed. Estimates have an awkward way of being exceeded, and the anticipated saving in labor by the introduction of any mechanical appliances is often far from being realized. Of course, I am not now speaking of those engineers who do not want to reduce the number of men in their works, and who know of nothing "more delightful to witness than the smartness, the neatness and the efficiency of a gang of men charging retorts in the old fashioned way." To such, these improvements in mechanical stoking (and all progress in labor-saving machinery) must, I suppose, appear as evidences of modern decadency, and as evils hardly to be tolerated. But I speak of those engineers who believe in "the general advancement of mechanical science," who wish to save their fellows brute-like labor, and who desire to adopt all possible means for the best and most economical manufacture of the commodity they deal in "for the use and convenience of man."

Is it really true that the new type of machine will "wipe away at once one half of the men required in charging a 20-foot retort in the ordinary way by machinery?" Obviously, with two machines as against four, there will only be half the previous number of machine men. But will there not generally be, in an average works, one man opening and one man shutting lids on each side of the bench as before? It seems so to me; and thus instead of eight men per shift, there would be only six—that is, you wipe away one-quarter. And in smaller works, and in making the comparison with a combined charging and drawing machine, would even this reduction in the retort house staff hold good? These are questions which only practice can decide, and the answers to which will vary greatly even then, according to the size of the works, the local conditions of labor, special circumstances, and the hundred and one things that come in to vitiate any attempted comparison.

I can corroborate the statements of the *Journal's* second article. Both the De Brouwer and the Paris machine "can put a charge into a 20-feet retort quickly, well, and without any pause or movement during the charge," and in both cases, "the level of the charge is all that can be desired." The discharging ram at La Villette did its work swiftly, admirably, and cleanly. I recognize in both types of machines new servants to be used for the benefit of the gas industry and the community, and I wish the makers of both machines all possible success. But I do not forget the magician's cry of "New Lamps for Old," and the foundations of inclined retorts remain unshaken.

AT the annual meeting of the Louisville (Ky.) Gas Company the stockholders named the following Directors: Udolpho Snead, D. X. Murphy, K. W. Smith, H. V. Loving and John Stites. The stockholders further signified their assent to the proposition that it was advisable to put the shares on a 6 per cent. instead of a 5 per cent. basis per annum.

The Late Mr. Wm. Foulis.—An Appreciation.[1]

By the death of Mr. William Foulis, the citizens of Glasgow have lost a citizen of whom they might well be proud, and the general body of gas engineers is a great deal the poorer by his loss. A very capable engineer, and an excellent manager, Mr. Foulis was greatly respected by gas engineers, and by all who had occasion to meet him in the discharge of his professional duties. I doubt whether the citizens of Glasgow ever fully realized their indebtedness to Mr. Foulis. By his wise conduct and management of their gas undertaking he saved them hundreds of thousands of pounds; for it was only because they had a man like him at the head of their gas undertaking that they enjoyed for so many years an efficient gas supply at a low price. When in the early nineties he induced the Glasgow Gas Committee to reduce the illuminating power of the gas supply from 26 candles to 21 candles he did a good day's work for Glasgow, and, I may say, for the gas industry generally. He was painstaking, thorough and straightforward in all that he undertook, and, as an engineer in a responsible position should be, he was not content to follow any leader. He cut out paths for himself, and he cut them out with discretion and wisdom, and to the advantage not only of his employers but of the gas industry as a whole. Respected and even admired by all who knew him, the death of Mr. Foulis will be deeply regretted by everyone who has the welfare of the gas industry at heart.

Mr. Foulis's death, in regard to which Sir George Livesey thus feelingly gives expression, through the *Gas World*, to the sentiments of the gas industry, took place at his residence, 2, Montgomerie Quadrant, Glasgow, on Monday afternoon. Mr. Foulis had been in a somewhat poor state of health for some time back. Not so very long ago he sought rest and recuperation at Bournemouth, and those who saw him on his return from that health resort had hoped that all immediate danger had passed. Only a fortnight ago he was in London attending the Engineering Conference, when he took part in a discussion as to the right quality and best means of testing coal gas. On Wednesday of last week he was in attendance at a meeting of the Glasgow Gas Committee, and as late as Saturday he was at his office. On the evening of that day, however, he was seized by an acute internal ailment, which all the medical skill of Glasgow could not alleviate, and he passed away, as we have stated, on Monday afternoon.

The death of Mr. Foulis is felt by many gas engineers as a personal loss, but we are only interpreting the feelings of a large number of them when we say that the sense of personal loss is almost overshadowed by the feeling that at a time when strong men are much needed in the industry a strong man and a sound engineer has been taken away. Mr. Foulis was a splendid example of the truth of the saying that the occasion makes the man. Born in St. Andrews, where his father was gas manager at the time, some 65 years ago, he obtained the customary "schooling" of the average Scottish boy of the time. When he was only 14 years of age he was apprenticed to a firm of mechanical engineers in Paisley, to which town his father had moved two years before to take the management of the gas works there. At the close of his apprenticeship he found an interval to attend classes at Glasgow University. But this interval was apparently of short duration, for soon after we find him employed in a Glasgow locomotive engineering works, presided over by a son of Mr. J. B. Neilson, of hot-blast fame. About this time he made the acquaintance of Mr. Angus Croll, and by him he was commissioned to proceed to the Mediterranean litoral and adjoining parts to erect and establish gas works. This work occupied him for some 7 years. On his return home, he settled in Glasgow, in partnership with Mr. W. R. Copeland, as engineer for gas, water and sewerage works. But the settlement was not for long. In the later sixties he was consulted by the Glasgow Corporation in their negotiations for the purchase of the two existing gas undertakings and when these negotiations terminated in a transfer of the undertakings to the Corporation, in 1869, Mr. Foulis was appointed engineer and manager.

It was a big post to confer upon a comparatively untried man, but Glasgow has never had cause to regret the step then taken, although it may be questioned whether the present citizens of Glasgow properly appreciate the service done them by the Town Council of 1869, in placing Mr. Foulis in charge of the gas works. It would be superfluous to record here the work that Mr. Foulis did for Glasgow during the 34 years he controlled the destinies of the municipal gas undertaking. In the earlier years of his charge he built a new gas works at Dawsholm, and, as the irony of fate would have it, he has been taken away when he was on the eve of completing a still greater scheme of gas works construction at Provan. Between these two landmarks in his service to Glasgow there could be filled in a record of service of which any man might be proud, and for which any corporation ought to be grateful.

Mr. Foulis took a leading part in adapting the Siemens regenerative system to the requirements of gas works; he was for years a practical exponent of the outside producer; he was the first gas engineer, in this country at least, to recover cyanogen from coal gas; and what he achieved, in conjunction with Sir William Arrol, in the way of retort charging and drawing machinery is too well known to need mention. Careful never to go too rapidly, he was yet always up to or in advance of the time, as witness the fact that so long ago as 1896 he showed the advantage, in incandescent gas lighting, of a prior mixture of the gas and air in the right proportions—a subject about which we are hearing so much at the present time.

As a man Mr. Foulis was reserved, but lovable to those who knew him best. As an engineer he was thoroughly sound, never going in for effect but for real utility, and one who could be safely followed. And he was always ready to give from the store of his experience to any fellow engineers who sought his advice. Perhaps the best tribute that the young engineer can pay to his memory is to read his presidential addresses to the Gas Institute in 1887 and to the Institution of Gas Engineers in 1896. They are addresses that give to thinking, as all his utterances did. "He thoroughly understood his work, and applied himself earnestly to make the Gas Department of Glasgow's enterprise a success." Thus said a writer who knew him well; and he might have added that he succeeded in his application. As evidence of the regard in which he was held by engineers outside gas circles, it may be stated that for two years in succession he was president of the Institution of Engineers and Shipbuilders in Scotland. Mr. Foulis is survived by a widow, and by a son who has just concluded an engineering apprenticeship.

1. By Sir George Livesey in the *Gas World*.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. WM. H. MERRITT, of the Lebanon (Pa.) Gas Company, informs us that the Directors have declared a semi-annual dividend of 4 per cent., payable since the 14th inst.

MR. THOMAS G. AGNEW, General Manager of the United Gas and Electric Company, of Mexico, is our authority for the statement that its Merida (Yucatan) plant is doing finely. The output has increased to the point that makes new storage plant a necessity, and in line with the general betterment proposed for the service 2 miles of main extensions have been arranged for. The local electric lighting concern, which was originally built and operated by the Siemens-Halske Company, of Berlin, Germany, is being reorganized, much to the discomfort and loss of the starting shareholders, many of whom were residents of Merida.

MR. A. W. COOK, of Susquehanna Pa., proposes to construct and operate a gas works at Deposit, N. Y.

THE proprietors of the Nassau County (L. I.) Gas Company, are preparing to extend their service from Baldwins to Freeport.

AT the annual meeting of the Penn Yan (N. Y.) Gas Light Company, Mr. William T. Morris was elected President and Secretary.

MR. FRANK D. MOSES, of Trenton, N. J., denies that he is in any way interested in the opposition gas scheme for that city. The baptismal name of the concern is the "Johnson Gas Light and Power Company."

THE Gas and electric lighting interests of Waterville, N. Y., have been merged. The name of the succeeding corporation is the "Waterville Gas and Electric Company."

DURING the month of June, 1,000 gas ranges were put in service by the Cincinnati Gas and Electric Company.

GOVERNOR BATES, of Massachusetts, has named Mr. Samuel George, of Haverhill, to succeed Mr. Charles H. Gifford, of New Bedford, on the State Board of Gas and Electric Light Commissioners. The new appointee, who is in his 42d year, has been prominent in politics (city and State) since 1887.

THE new storage holder for the Plainfield (N. J.) Gas and Electric Light Company, will be located at East 4th and Washington streets.

It is to be of the 2-lift order, and will be constructed by Messrs. Bartlett, Hayward & Company, of Baltimore, Md.

THE shrreholders of the Nantucket (Mass.) Gas Light Company, have assented to the proposition to change its corporate title to that of the Nantucket Gas and Electric Compeny.

THE Fall River (Mass.) Gas Works Company has declared a semi-annual dividend of 5 per cent., payable the 1st prox.

AT the annual meeting of the Bridgeton (N. J.) Gas Light Company, the following officers were chosen: Directors, H. W. Elmer, Daniel Bacon, George H. Whipple, Samuel P. Fithian and Jno. Smalley; President, Daniel Bacon; Secretary and Auditor, H. W. Elmer; Superintendent and Treasurer, B. F. Harding—it might be remarked just here that Mr. Harding entered the service of the Bridgeton Company in 1872.

MR. DANIEL ELMER, at one time President of the Bridgeton (N. J.) Gas Light Company, died at his home in Bridgeton, the morning of the 12th inst. He was in his 54th year.

THE Corning (N. Y.) Gas and Electric Company has awarded to the Gas Machinery Company, of Cleveland, O., a contract for the installation of 2 purifiers to be operated by means of the Machinery Company's duplex reversing and by-pass valve. The contractors will also furnish a coal gas apparatus up to an output of 300,000 cubic feet per day.

THE Standard Gas and Lighting Company has filed articles of incorporation with the County Recorder of Des Moines, Ia. The concern is to manufacture gasoline lighting plants; it is capitalized in $50,000; and its officers are: President, A. E. Avery; Secretary, C. B. Smith.

THE Eighteenth Annual Outing of the Jeffrey Manufacturing Company's employees, which was held at Olentangy Park, Columbus, O., was a great success, thanks to the elever management of Mr. J. A. Jeffrey and Messrs. Harry Loudenslager and Walter Jeffrey.

MR. JOHN J. CUMMINS, the General Manager of the Syracuse (N. Y.) Lighting Company, has been elected a Director of the State Bank of Syracuse, and had also been chosen to serve as a Trustee of the Trust and Deposit Company of the same city. He deserves his promotion, in that his work is not of the jerky "executive ability" sort, but of the kind that seldom or ever requires revision at his hands or from those of his superiors.

ON the 1st inst., the Directors of the Charleston (S. C.) Consolidated Railway, Gas and Electric Company put the concern on a dividend paying basis. While the sum divided (½ per cent. for the last half year) was small, it nevertheless will be gratefully accepted by the shareholders, who had about made up their minds that nothing was to be their portion for many half years to come.

"A VERY enjoyable time was the lot of those who shared in the dinner tendered to Mr. E. A. Reeves, General Manager of the Reeves Manufacturing Company, of New Haven, Conn., which was served for the purpose of letting him know that many of his associates and employees remembered that he had attained his 30th year. The dinner was served at the Pleasant View Hotel, West Haven, and the toastmaster was Mr. William Reeves. When the affair was at an end Mr. E. A. Reeves was richer in this world's goods, as follows: A handsome smoking set, that included a wonderfully built meerschaum pipe—the gift of the employees of the concern; and an up-to-date gold chronometer, the gift of the shareholders. You may take it for granted that he will use them both.—F. B. L."

THE Massachusetts Board of Gas and Electric Light Commissioners has issued the following order, in the instance of the petition of the Pittsfield Coal Gas Company for the right to readjust its capitalization: "On April 21, 1902, for the reasons then stated, the Board approved the issue by this Company of first mortgage bonds for $50,000, the proceeds of the same to be applied to the payment of the Company's indebtedness at that time. None of these bonds have been issued and the indebtedness is now represented in the promissory notes of the Company. Having decided not to issue the bonds, the Company has requested the Board to annul its approval thereof and to permit the issue of new stock sufficient to pay a like amount of these notes. Since the last approval of its securities the Company has undertaken to extend its distributing system into the town of Dalton and to purchase land contiguous to its present works for the erection of a water gas plant. The cost of this work, as now planned, will be substantially in excess of $25,000. The following is therefore adopted:

"On the petition of the Pittsfield Coal Gas Company, pursuant to the provisions of section 24 of Chapter 109 of the revised laws, for the approval of an issue of new capital stock of the par value of $75,000 for the objects named in said petition, after public notice and hearing, it being deemed by the Board that the amount hereinafter named is reasonably necessary for the purpose for which such issue of stock is authorized, it is

"*Ordered*, that the Board approves of the issue by the Pittsfield Coal Gas Company, in conformity with all the requirements of law relating thereto, of 650 shares of new capital stock of the par value of $100 each; the proceeds thereof to be applied to the following purposes and no other, to wit: The proceeds of 435 shares to the payment of an equal amount of the floating debt of the Company represented by its promissory notes now outstanding and the proceeds of 215 shares to the cost of extending its distributing system into the town of Dalton and the purchase of land adjoining its present works and suitable for the construction of a water gas plant. And for the purposes of determining the price or rate at which the said shares shall be offered proportionately to the stockholders of said corporation, pursuant to the provisions of section 30 of Chapter 109 of the revised laws, it is further

"*Ordered* and determined by the Board, taking into account previous sales and other pertinent conditions, that the market value thereof for the purpose aforesaid, be fixed at $115 a share, and if any share shall remain unsubscribed for by the stockholders entitled to take them under the provisions of said section, it is further

"*Ordered* that all such sales shall be offered for sale at some suitable place in the city of Pittsfield and that notice of the time and place of such sale be published in the Boston *Daily Advertiser*, a newspaper published in the city of Boston, the Springfield *Republican*, a newspaper published in the city of Springfield and in the Pittsfield *Daily Eagle*, a newspaper published in the city of Pittsfield. And conformably to the request of the Company relative thereto, it is further

"*Ordered*, that so much of the order of this Board adopted on April 21, 1902, as approved the issue by said Pittsfield Coal Gas Company of first mortgage bonds to an amount not exceeding $50,000 be and the same is hereby rescinded."

THE following letter, which explains itself, is being mailed to every gas company in the country:

"We are desirous of preparing a complete illustrated and descriptive catalogue of all industrial fuel gas appliances that are now in successful use in this and other countries, and to this end we will greatly appreciate your kindness and assistance if you will send us drawings and detailed descriptions of all such appliances as may be in use in your city, or refer us to manufacturers of same with whom we may correspond. By 'industrial fuel gas appliances' we mean especially those that are used for manufacturing and industrial purposes, and, in fact, anything aside from domestic fuel gas appliances now in common use for cooking, heating water and rooms, etc.

"Your description of these appliances, in addition to photographs and drawings of same, should state the purpose for which the appliance is used, the cost of its construction, its rate of gas consumption, the cost and satisfactoriness of the work done by it in comparison with appliances using other fuels, etc.

"We intend to make this catalogue a valuable one for all gas companies, and copies of it when published will be sent gratis to all gas companies who have favored us with their assistance as above requested. It is hoped that you will so appreciate the desirability and usefulness of the proposed catalogue that you will not hesitate at the slight trouble and expense incident to your complying with this request.

"Responses should be sent to the undersigned not later than August 1, 1903. "THE DENVER GAS AND ELECTRIC COMPANY,

"IRVIN BUTTERWORTH, Manager."

THE Capital City Gas Company, of Des Moines, Ia., has paid into the city treasury the sum of $2,678.91, which amount represents 2 per cent. of the Company's gross receipts for the sale of gas for 6 months ended June 30th. That payment shows how marked the increase is in the Company's sendout.

THE Pintsch Compressing Company is planning to erect a sub-station in Columbus, O.

MR. ANDREW J. SUTHERLAND, formerly in charge of the plant of the Herkimer (N. Y.) Gas Company, died in that city the night of the 8th inst. He was in his 55th year.

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO.,
PROPRIETORS.

THOS. J. CUNNINGHAM,
ELBERT P. CALLENDER,
EDITORS.

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OHIO GAS LIGHT ASSOCIATION.

NOTIFICATION RESPECTING ADVERTISING.

Orders for new advertising, or for changes in standing advertisements, to insure attention in the issue following their reception, must be in hand any time of Wednesday.

AGENTS:

New York—American News Co., 39 and 41 Chambers St.
Germany—Lemcke & Buechner, of New York.
England—Aug. Siegle, 30 Lime Street, London.

MONDAY, JULY 20, 1903.

The Market for Gas Securities.

The astute gentlemen who wage mimic war are between themselves, having control of the main financial citadels as their coigns of vantage, have certainly slaughtered the bulls—the lambs were killed in the early spring, when the chefs of the financiers were anxious to secure tender, white meat. This week we hope saw the culmination of the episcopal-baptist contest, wherefore we may look for the end. To come back to earth and confront the results from a truly catholic standpoint, we know that Consolidated sold well below 190, and that Brooklyn Union touched the latter figure. There is no reason that can be advanced for the shrinkage, for of a verity both stocks are a purchase at anything under 250; that is to those who can buy them outright, keep taking their dividends and waiting with either Company's proprietors to share in the final reward.

Some of the holy men would like to purchase Mutual, of New York, at 285, but our advice to the ungodly is to do a little buying on such terms for their own account. The real feature of the market is Peoples, of Chicago, which withstood the attacks of the godly and the gamblers with fortitude. It is futile, in the present temper of the market, to predict anything, but we think it safe to say that any gas stock on the list looks a temptation to purchase.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

JULY 20.

☞All communications will receive particular attention.

☞The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated	$73,177,000	100	188	188½
Central Union, Bonds, 5's	3,000,000	1,000	109	111
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	118	120
Metropolitan Bonds	658,000	.	108	112
Mutual	3,500,000	100	285	315
Municipal Bonds	750,000	.	..	
New Amsterdam Gas Co..				
Bonds, 5's	11,000,000	1,000	107½	108
Northern Union, Bonds, 5's.	1,250,000	1,000	106	107
New York and East River				
Bonds 1st 5's	3,500,000	1,000	110	113
" 1st Con. 5's	1,500,000		109	111
Standard	5,000,000	100	131	..
Preferred	5,000,000	100	152½	..
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115½	118
Yonkers	299,650	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	192	199
" " Bonds (5's)	15 000,000	1,000	119	119½
Bay State	50,000,000	50	¼	⅜
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	28	30
" 1st Mtg. 5's	509,000	1,000	93	96
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	8½	7
" " Bonds, 5's	5,256,000	1,000	73	76
Capital, Sacramento	500,000	50	.	35
Bonds (6's)	150,000	1,000	..	..
Central, San Francisco	1,900,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104¼
Cincinnati Gas & Elec. Co.	29,500,000	100	96½	97
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,500,000	1,000	101	101½
Columbus (O.) Gas Lt. & Heating Co	1,682,750	100	88¼	89¼
Preferred	3,026,500	100	107½	109
Consumers, Jersey City Bonds	500,000	1,000	100	102
Consumers, Toronto	1,700,000	50	218	225
Consolidated Baltimore	11,000,000	100	..	68⅝
Mortgage, 6's	3,500,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	15	17
" Con. Mtg. 5's	880,000	1,000	85	87
Consolidated G. & E. Co.'s.				
Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co	4,825,500	50	..	89
" Prior Lien 5's	5,603,000	1,000	99½	100
Detroit Gas Co., 5's	981,000	1,000	77	79
" Inc. 5's	16,000	100	98½	100
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	39	40
Fort Wayne	2,000,000	..	..	..
" Bonds	2,000,000	..	55	..
Grand Rapids Gas Lt. Co. 1st Mtg. 5's	1,225,000	1,000	104½	105
Hartford	750,000	25	245	265
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	80
" Bonds, 6's	2,650,000	..	104¾	106
Jackson Gas Co	250,000	50	73	75
" 1st Mtg. 5's	220,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	102	104
Laclede, St. Louis	10,000,000	100	..	.
Preferred	2,500,000	100	92	..
Bonds	10,000,000	1,000	109½	110
Lafayette Gas Co., Ind.	1,000,000	100	.	60
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	130	140
Madison Gas & Elec. Co.				
" 1st Mtg. 6's	350,000	1,000	107½	108¼
" 6 per cent. scrip, due 1910	100,000	25	85	87
Montreal, Canada	2,000,000	100	218	184¾
Nashville Gas Lt. Co.	1,000,000	100	110	..
Newark, N. J., Con. Gas Co	5,000,000	..	56	58
Bonds, 6's	4,600,000	..	105	105¾
New Haven	1,000,000	25	300	325
Oakland, Cal.	2,000,000	..	46	47
" Bonds	750,000	..	..	.
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	96⅝	96¾
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	..	..
2d "	2,500,000	1,000	104	..
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	0,000,000	100	51½	52
St. Joseph Gas Co.				
" 1st Mtg. 5's	751,000	1,000	95	96½
St. Paul Gas Light Co.	1,500,000	100	45	47
1st Mortgage 6's	650,000	1,000	113	116
Extension, 6's	600,000	1,000	112½	115
General Mortgage, 5's	2,465,000	1,000	92	93
Syracuse, N. Y.	1,975,000	100	46	48
Bonds	2,047.000	1,000	98½	99½
Washington, D. C	2,600,000	20	310	320
First mortgage 6's	600,000	..	..	..
Western, Milwaukee.				
Bonds, 5's	4,000,000	..	109½	110
Wilmington, Del.	600,000	50	232	..

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WANTED.

YOUNG MAN, seven years' experience in all branches of the gas business, with company sending out 600,000 cubic feet per day, desires position as superintendent of manufacture and distribution, in small city in Illinois or States surrounding.

Address, "SUPERINTENDENT,"
1467-1 Care this Journal.

WANTED,

Position as Manager of a Gas Company

That is much in need of a man thoroughly familiar with all details of the business. A position where the business and public confidence are much impaired, requiring the right man, at the right place, at the right time, preferred.

1462-tf Address, "ABILITY," care this Journal.

POSITION WANTED

AS MANAGER or SUPERINTENDENT,

By a successful hustler for new business. Experienced in selling gas stoves; laying high and low pressure mains; understands the manufacture of coal and water gas in detail; also, reconstruction of benches and water gas apparatus. Superintendent of gas company for a number of years. Will find me up-to-date and energetic young man. Can furnish best of references. Address,

1465-5 "PUSHER," care this Journal.

WANTED,

A young man, thoroughly experienced in operating regenerative benches and in the general practice of coal gas working, to take charge of the manufacturing and distributing departments for gas company in town of 30,000 population in the Southwest. Salary, $100 per month. Address, stating experience and giving references,

1467-2 "S. G. L.," care this Journal.

GAS COMPANY

In suburbs of New York wants a young man as bookkeeper and cashier. Address, stating age, experience and salary expected,

"F. G. F.,"
1467-1 Care this Journal.

WANTED,

Capable Man as Manager of Gas and Electric Plant

In small seacoast town in California. Must have had some experience, and especially in connection with development of gas business. Salary, $1,500 annually, with opportunity for advancement. Town growing; good field; position permanent. Address, with references and stating experience,

CALIFORNIA LIGHT AND FUEL COMPANY,
1465-4 576 Parrott Building, San Francisco, Cal.

WANTED,

An Engineer Experienced with Coke Ovens and Coke Oven Gas, Chemisty of Gas, Metallurgical Work.

A man of technical training and practical experience. Must be qualified to superintend construction. Address, stating experience and references, "BY-PRODUCT,"
1466-2 Care this Journal.

WANTED,

AN 8-INCH or LARGER EXHAUSTER,

With or without engine. Address,

NEWTOWN AND FLUSHING GAS CO.,
1466-2 FLUSHING, N. Y.

WANTED,

SECOND-HAND STATION METER,

Suitable for gas company manufacturing from 3 to 4 million cubic feet of gas per year. Give manufacturer's name, capacity and condition. Price figured on, F. O. B.

Address, GEO. W. GRAVES, care "THE HICKS,"
1465-tf Asbury Park, N. J.

METER FOR SALE.

One 300-Light Maryland Meter.

The Maryland Meter Company will vouch for good condition of this meter. For particulars, address,

1465-tf OTTAWA GAS LIGHT & COKE CO., Ottawa, Ills.

FOR SALE.

Two Rectangular, Cast Iron, Water Tube Condensers, 5 feet 6 inches wide, by 15 feet 10 inches high, by 36 feet 10 inches long, with 20-inch valves and connections.

One Rectangular, Cast Iron Scrubber, 5 feet 6 inches wide, by 12 feet high, by 36 feet 10 inches long, with 20-inch valves and connections.

Sixteen Sections of Cast Iron Hydraulic Main, 8 feet 4 inches long by 24 inches, for benches of 6's; dip and bridge pipes; 7-inch ascension pipes; supports for hydraulic main; 4 take-off ends, with 12 inch outlets; adjustable valves, with Hutchison tar draw-off pots.

Seventy-eight Self-Sealing Mouthpieces, each 13 by 24.

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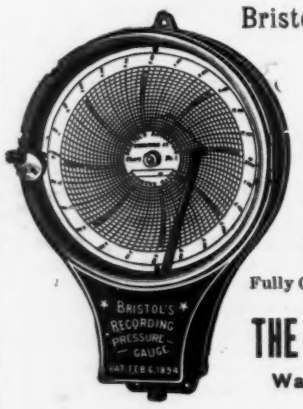

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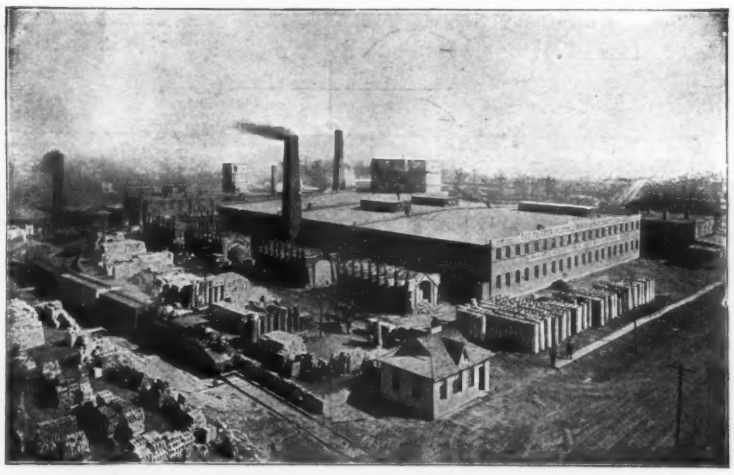

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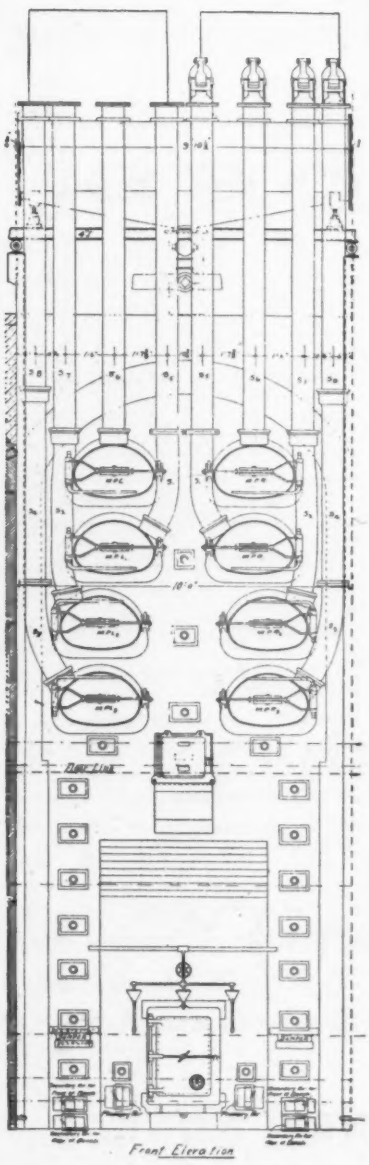

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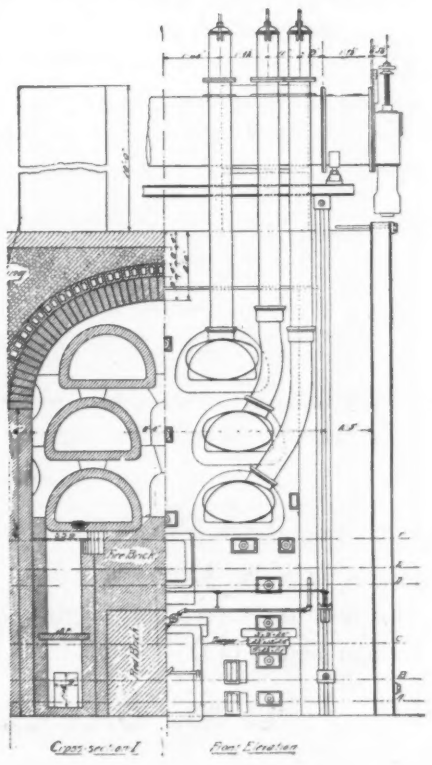

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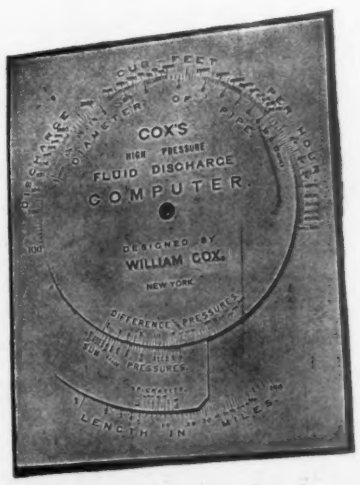

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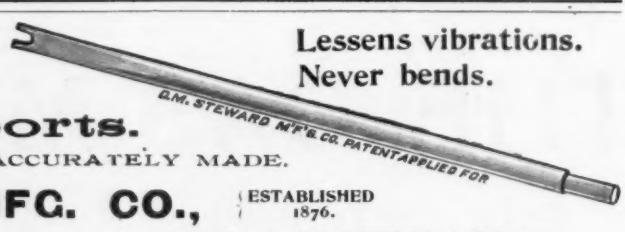

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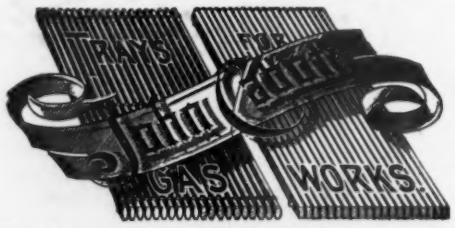

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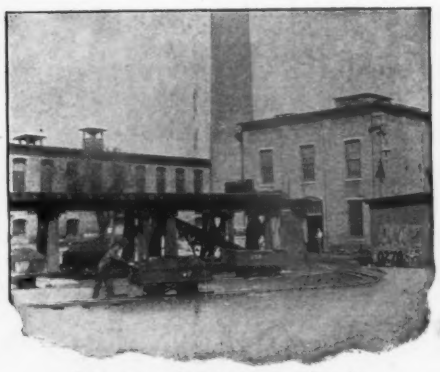

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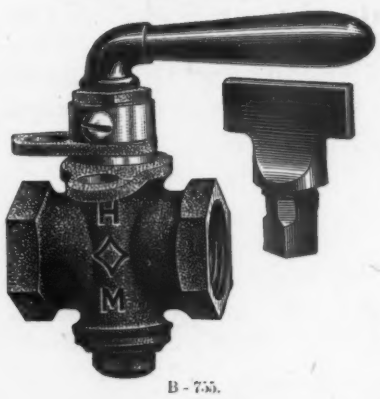

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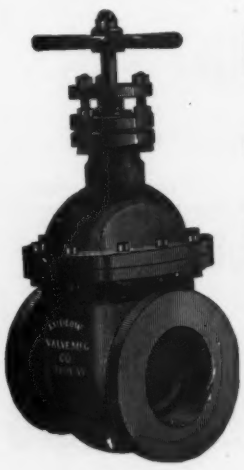

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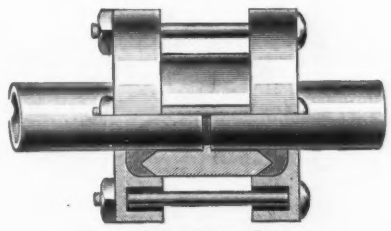

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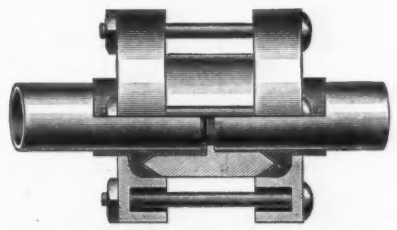

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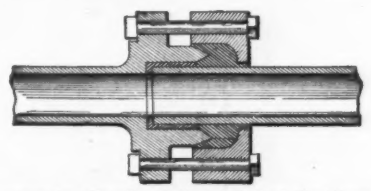

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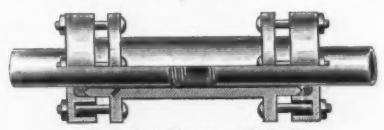
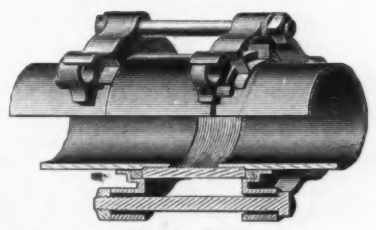


Regular Sleeve. Style 2.



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BY UTILIZING A

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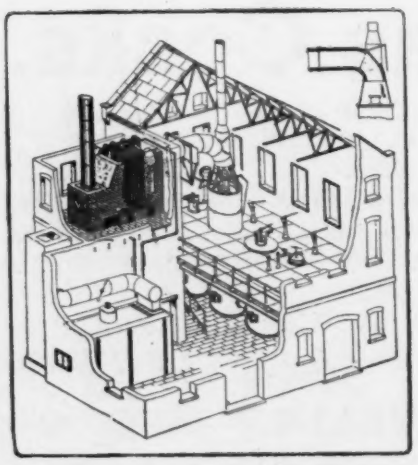

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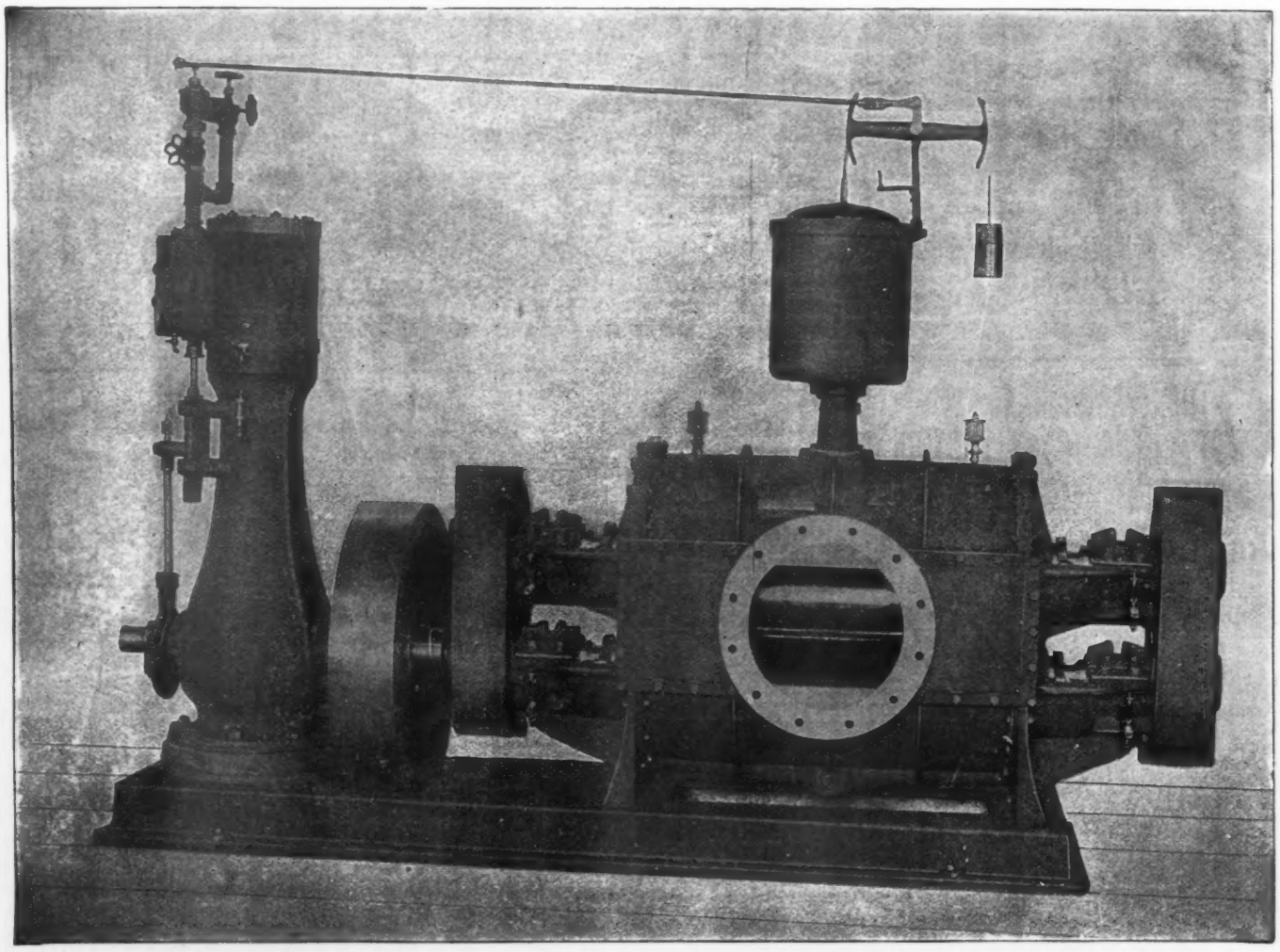

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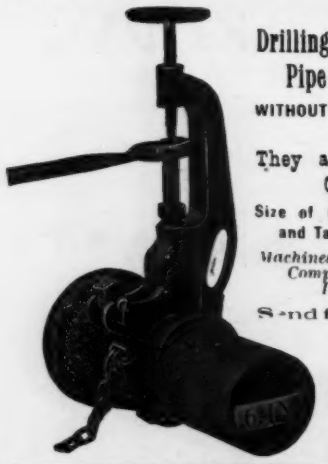

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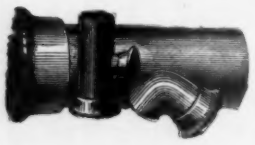

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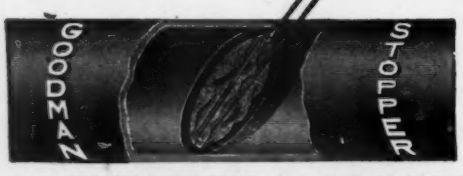

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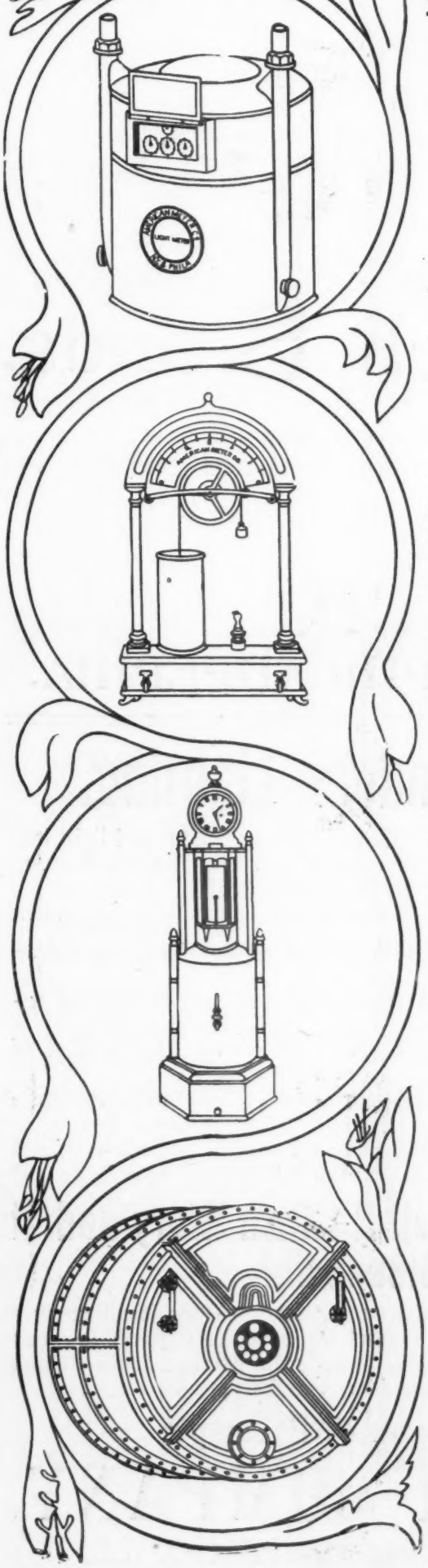

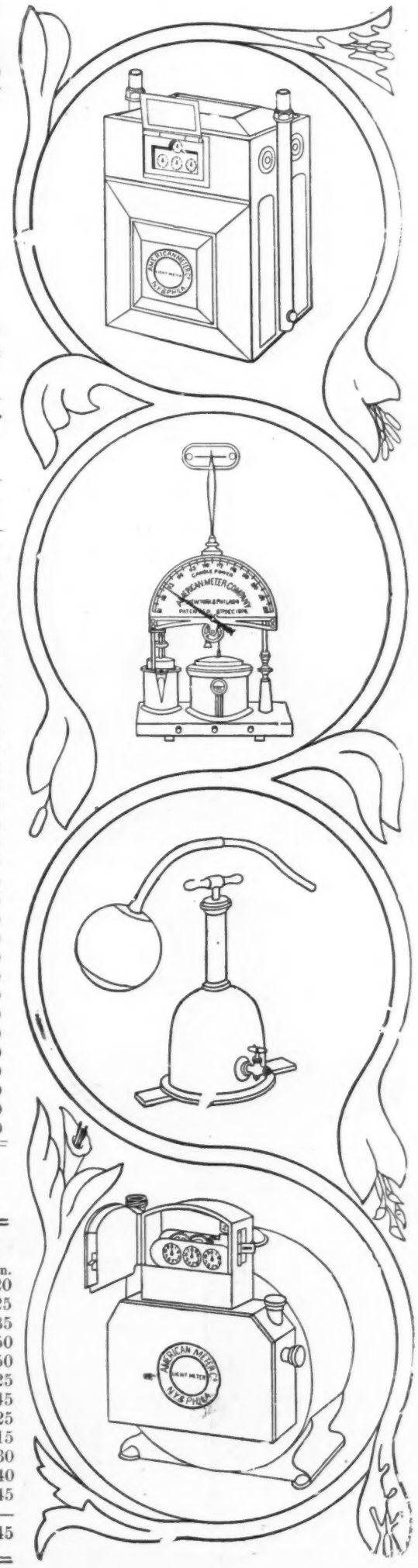

PUBLIC LIGHTING TABLE.

AUGUST, 1903.

Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Table No. 1. Following the Moon. Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Table No. 2. New York City. All Night Lighting. Extinguish.
				P.M.	A.M.
Sat.	1	11.20 PM	3.50 AM	7.10	3.30
Sun.	2	12.10 AM	4.00	7.10	3.30
Mon.	3	1.00	4.00	7.10	3.30
Tue.	4	1.40	4.00	7.10	3.30
Wed.	5	2.30	4.00	7.10	3.30
Thu.	6	No L.	No L.	7.10	3.45
Fri.	7	No L. FM	No L.	7.10	3.45
Sat.	8	No L.	No L.	7.10	3.45
Sun.	9	7.30 PM	8.40 PM	7.10	3.45
Mon.	10	7.30	9.10	7.10	3.45
Tue.	11	7.30	9.40	7.10	3.45
Wed.	12	7.30	10.10	7.10	3.45
Thu.	13	7.30	10.40	6.55	4.00
Fri.	14	7.30	11.20	6.55	4.00
Sat.	15	7.30 LQ	11.50	6.55	4.00
Sun.	16	7.20	12.40 AM	6.55	4.00
Mon.	17	7.20	1.30	6.55	4.00
Tue.	18	7.20	2.30	6.55	4.00
Wed.	19	7.20	4.10	6.55	4.00
Thu.	20	7.20	4.10	6.45	4.10
Fri.	21	7.20	4.10	6.45	4.10
Sat.	22	7.20 NM	4.10	6.45	4.10
Sun.	23	7.10	4.20	6.45	4.10
Mon.	24	7.10	4.20	6.45	4.10
Tue.	25	7.10	4.20	6.45	4.10
Wed.	26	7.10	4.20	6.45	4.10
Thu.	27	8.40	4.20	6.30	4.20
Fri.	28	9.20	4.20	6.30	4.20
Sat.	29	10.00 FQ	4.20	6.30	4.20
Sun.	30	10.50	4.30	6.30	4.20
Mon.	31	11.40	4.30	6.30	4.20

TOTAL HOURS LIGHTING DURING 1903.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	245.00	January	423.20
February	192.00	February	355.25
March	201.00	March	355.35
April	167.20	April	298.50
May	152.00	May	264.50
June	131.00	June	234.25
July	140.40	July	243.45
August	156.20	August	280.25
September	171.20	September	321.15
October	198.20	October	374.30
November	216.30	November	401.40
December	232.10	December	433.45
Total, yr.	2203.40	Total, yr.	3987.45

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The cut tells the story—but not all of it. Get one lamp and light it—then the tale's told from beginning to end. For one Welsbach Gas Arc Lamp is a better salesman than 20 pages of advertising.

Here's what it would show if you give it a chance to prove its worth:

1. A mechanical construction and finish that insures the greatest durability.
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4. A by-pass cock so constructed as to permit all or only one mantle burning at a time.
5. A pilot light that consumes but 1 foot of gas in 24 hours. Costs $\frac{1}{10}$ of a cent a day.

Give it a Chance to Tell its Own Story and it Won't Disappoint.

Let us send you one lamp—doesn't cost a fortune—and it will answer every question you put to it; make good on every test given it. You know the only proof of the pudding? What's the use in a fellow telling you it tastes good? Taste it yourself, then you know.

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Winsted, Conn.	Washington, D. C.	Cicero, Ills.
Canon City, Col.	Boone, Ia.	Chicago (Ogden Co.)
Schenectady, N. Y.	Pueblo, Col.	Easton, Pa.
Hagerstown, Md.	Charlotte, N. C.	Lawrence, Mass.
Malden, Mass.	Fall River, Mass.	Council Bluffs, Ia.
Bridgeport, Conn.	Duluth, Minn.	Chattanooga, Tenn.
Albert Lea, Minn.	New York (Mutual Co.)	

TOTAL SETS TO JULY 1, 1903, ... 51
TOTAL DAILY CAPACITY, ... 55,150,000 cubic feet.
TOTAL SETS TO DATE, ... 498
TOTAL DAILY CAPACITY, ... 354,830,000 cubic feet.

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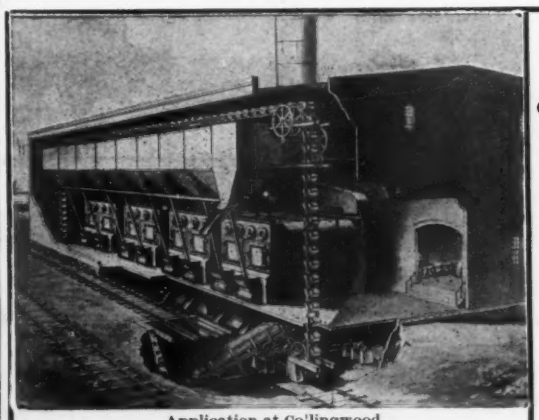

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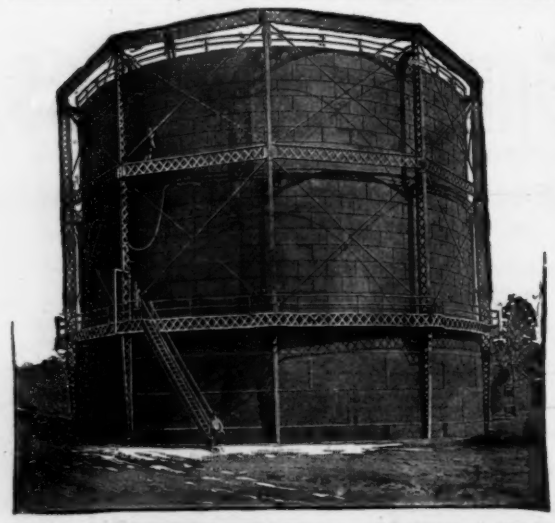

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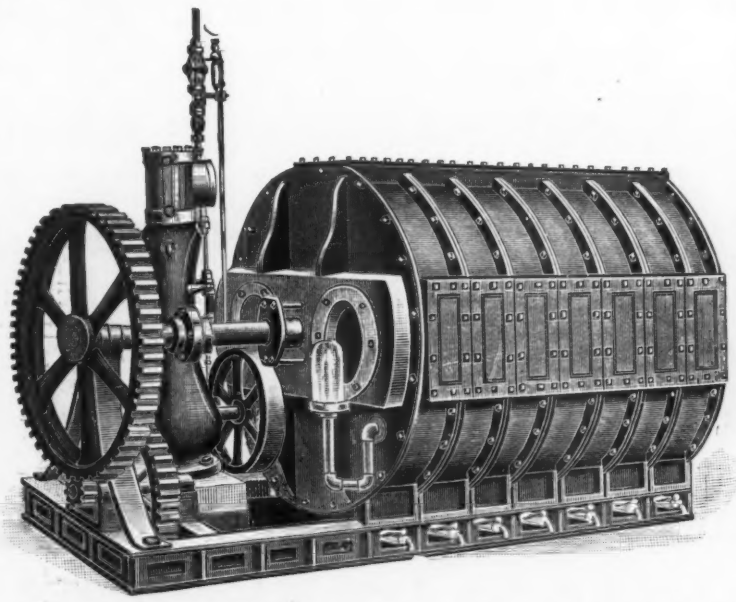

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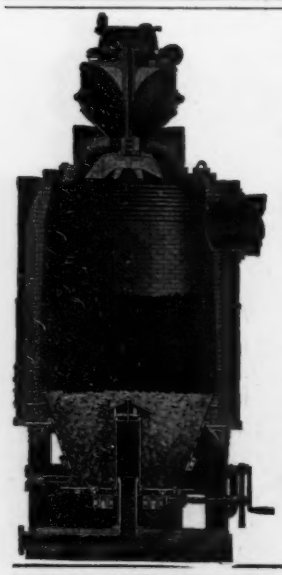

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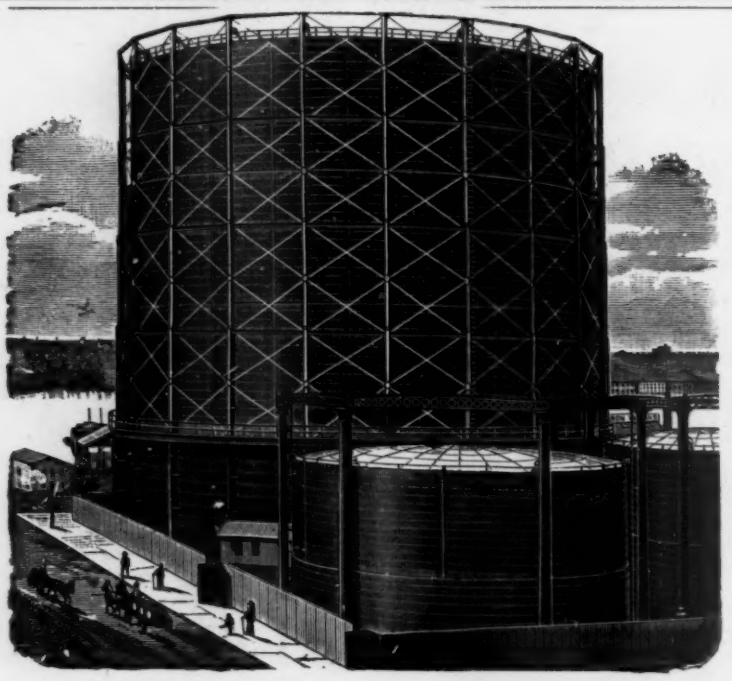

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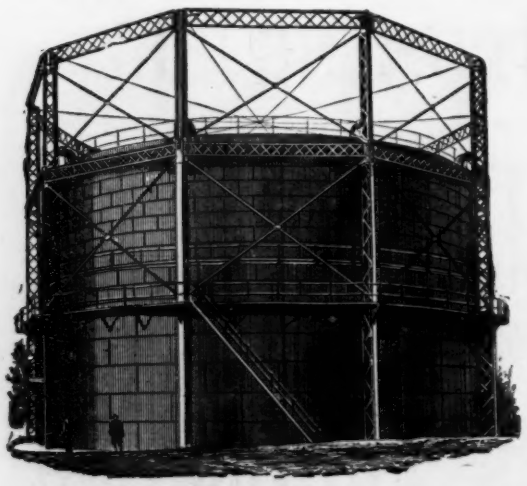

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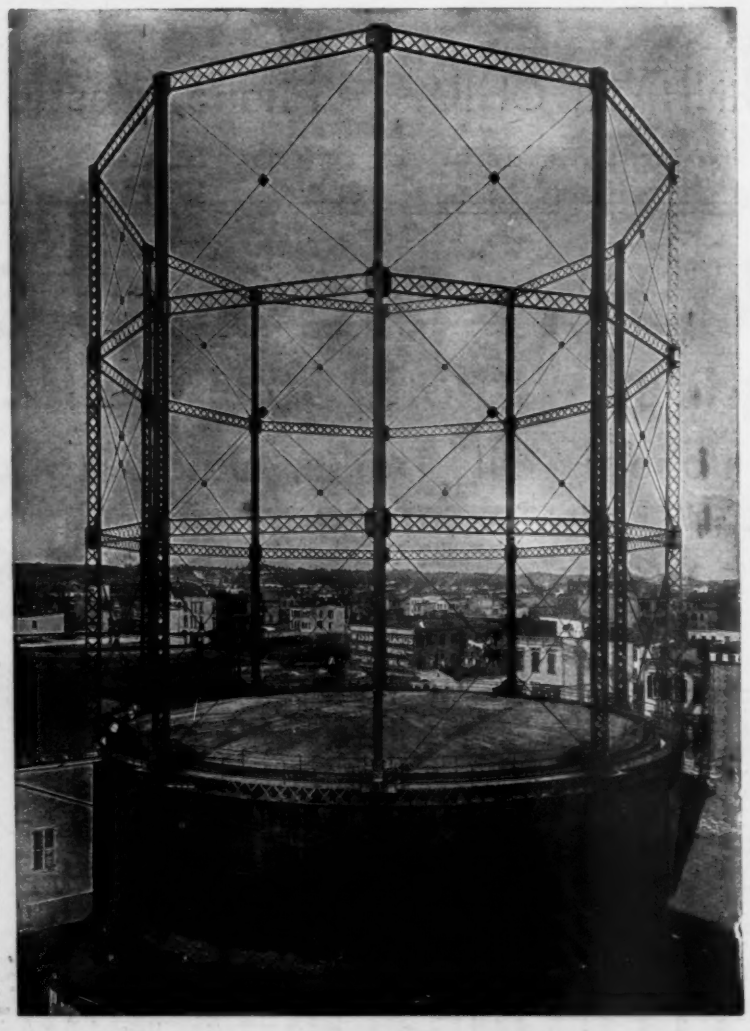

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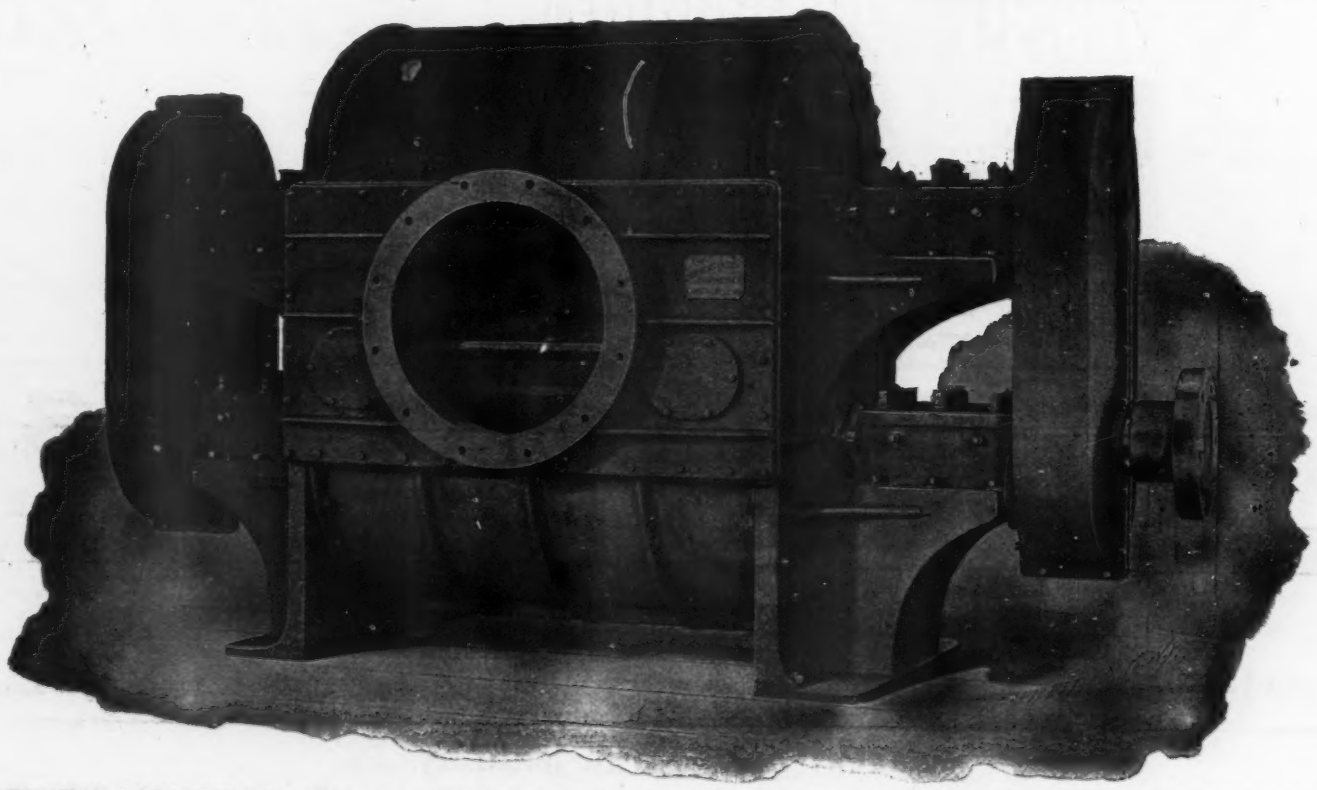

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